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NATURE

"To the solid ground
Of nature trusts the Mind that builds for aye."—Wordsworth

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COLLABORATION IN EUROPE

FROM time to time in the past few months, reference has been made in these columns to the need for consideration of the reconstruction which will have to be faced after the War. The King, in his Christmas Day broadcast, referred to the new unity which comes from common perils and common suffering endured, and pointed out that we must hold fast to this spirit of unity in the days to come, both in our own lives and even more among the nations. The Archbishop of Canterbury has stressed the urgency of reconstruction problems. Let there be no mistake. If they are given the time, the Nazis can and will build a new order in Europe embracing not only France but also those other countries on which their tyranny has in succession descended. That will not be an order for free men, and its basis, as Mr. Bevin pointed out in a recent vigorous address, will be the racial superiority of the Germans.

The two outstanding characteristics of the War are indeed, first, that it is in substance a civil war, and secondly, that the conditions which led to its outbreak will not be cured or reformed merely by victory and the rehabilitation of pre-War Europe. To the first the presence, legalized by the Allied Forces Act, in Great Britain of six foreign armies, training under their own flags, their own commanders, their own military law, testifies. We must also count among the freemen of Europe the Germans, Austrians, Italians and Spaniards who are still eager to serve as pioneers and sappers for the intellectual engineering jobs of the War and post-War, as well as the many refugees now being mobilized for technical service through the International Labour Branch of the Ministry of Labour.

From this derives our right and responsibility in opposing the Nazi regime to call upon the love of liberty and respect for human rights all over the world and make ourselves their champion. This involves, as Mr. Bevin so clearly insisted, the readiness to face great changes in our own society. Further, our present propaganda seems to be handicapped by lack of understanding of democracy in Europe, and until we show ourselves in the War and in our plans for the future more of a democratic nation, we shall not fire the imagination of Europe or of our own society in a way that is commensurate with the leadership devolving upon us.

Consciousness of this is clearly betrayed in Mr. Bevin's recent speeches, and lies at the basis of the demands being voiced for an official statement of our own war aims. A statement of the basic principles which we intend to see embodied in the new world order is an important contribution to that end, and an assurance that a Cabinet committee is working unremittingly on a design for twentieth-century living, in the sphere of international affairs as in that of reconstruction at home, might reasonably be asked.

Some token or expression of the forward-looking mind and an indication that the research and investigations and fundamental thinking about the problems really involved are the first essentials towards developing relations with the submerged democratic movements abroad, is the theme ably argued by Mr. Francis Williams in his "War by Revolution"[1]. Mr. Williams argues that we can achieve our main object in the War by adopting the strategy of revolution. We must disrupt the Nazi system from within by appealing to the vast numbers of men and women, both in the occupied countries and in Germany itself, who are on the side of democracy against authoritarianism. This involves re-stating the democratic faith as a revolutionary faith, and taking the offensive everywhere, using those elements of the population in every country in Europe who are on the side of a new and true democracy.

This is also the theme of a series of world order papers recently published by the Royal Institute of International Affairs[2]; but the outstanding impression left by these papers is the distance we have yet to travel and the amount of work, both educational and research, which must be carried out before we can look for the establishment of a new order. There can be no international reconstruction, no establishment of a new world order, unless, as Sir John Fischer Williams argues in his outline of the minimum requirements of an effective federation which may be possible at the end of the present War, the minds and wills of those who command the obedience and embody the desires of humanity are set with friendly purpose to the achievement of the task. For all their lucidity and moderation, neither Sir John Fischer Williams nor Sir William Beveridge in his paper on peace by federation, are really any more convincing in their exposition of federation than Mr. R. G. MacKay's excellent "Federal Europe". For this there are two causes. First, the advocates of federalism have as yet scarcely dealt in any adequate measure with its practical difficulties. This can indeed be due in part to the tentative approach to the problem characterizing the soundest and ablest of its advocates. It may be due much more to the difficulty of finding an adequate basis in common interests, traditions, habits of thought, language, geographical continuity or the like, without which, as Prof. Gilbert Murray points out, a federation can scarcely maintain itself at all.

It follows from this that, should obstacles make actual federation at the end of the War unattainable, other steps must be taken for preserving the general peace. Sir William Beveridge, in discussing an approach to the German people, to be used possibly in such ways as Mr. Williams indicates, suggests indeed that we should state frankly our willingness to consider alternative proposals from the other side for the elimination of war, and he lays stress on the need for eliminating all sense of injustice and for handling the colonial and economic problems of the world on lines designed to that end as well as to the improvement of the standard of living. A first step towards the latter would be an International Reconstruction Commission, coming into action on the day that fighting stops, and charged with the duties of relieving distress, repairing war damages, and re-establishing prosperity for all at the common charge of all. One characteristic of these papers is, indeed, the consensus of opinion as to the importance of building on what foundations already exist and have proved their value.

The second point on which the consensus of opinion is remarkable is the necessity of some positive attempt to diminish the economic causes of war. Mr. P. Horsfall, in a paper entitled "Doubts as to the Imminence of the Millenium", remarks that it is neither a futile nor a mean ideal to work for this end through the co-operation of sovereign communities, without endeavouring to merge their distinctive national loyalties in a forced allegiance to a new State. The institutions and aims of any new association of nations must have regard not only to the hopes but also to the experience of mankind. Prof. L. Robbins's paper is indeed devoted to the economic factors tending to make for international diversity, and he shows that the great danger is not planning in general but independent planning by independent States. While he looks on the idea of complete and immediate federalization of all Europe immediately after an armistice as based on a delusion, he urges that out of the close associations of the present conflict there may come some permanent nucleus of stability, with sufficient power to ensure a breathing space in which the building of a more extensive organization may proceed with due care and circumspection.

There can be no doubt either that great difficulties will have to be overcome to establish a new European order; or as to the necessity of establishing some effective form of international co-operation, whether in a federal system or some modification of the League system. The plans for rebuilding Europe must be well thought out and carefully laid long before the opportunity of rebuilding arises. If Europe is to pass from an international system of conflict and war to one of law and co-operation, the machinery of its organization, as Mr. L. Woolf truly remarks in "The War for Peace", must be such as encourages the growth of the psychology of internationalism at the expense of the psychology of nationalism. This attitude forms the starting-point indeed for the offensive propaganda outlined alike by Mr. Williams in "War by Revolution" and in the pamphlet "How We Shall Win" issued by Federal Union[3]. We can only hope to play our full part as champion of freedom and of that part of mankind's great heritage which derives from the creative powers of individuality and respect for human personality when we can show the world that we can offer a programme of freedom and reconstruction to meet twentieth-century needs.

[1] War by Revolution. F. Williams. Pp. 171. (London: George Routledge and Sons, Ltd., 1940.) 5s. net.

[2] World Order Papers. First Series. Pp. 176. (London: Royal Institute of International Affairs, 1940.) 3s. 6d. net.

[3] "How We Shall Win". (The Federal Union, 44 Gordon Square London, W.C.1.)

QUI S'ACCUSE S'ACQUITTE

A Mathematician's Apology
By G. H. Hardy. Pp. vii + 94. (Cambridge: At the University Press, 1940.) 3*s*. 6*d*. net.

THIS is a slight book. From such cloistral clowning the world sickens. It purports to be an apology for a life misspent in mathematics and for the sort of mathematics on which it has been misspent—'real' mathematics as the entirely useless and to the 'real' mathematician the more profound part, in contradistinction to the 'trivial' part, in the culprit's view ugly in some sort of direct ratio to its usefulness. "Anyone who defends his subject will find that he is defending himself," and the last chapter is autobiographical. The court is of opinion that no such charge ought ever to have been or ever has been brought, and that it is unwise for the defendant to undertake the conduct of his own prosecution.

It is a personal vindication—much in the spirit an artist might confide in the public—defending himself and his particular clique, the 'real' artists[*], from a possible charge of wasting their talent and explaining their curious canons of beauty and ugliness. As he himself states, few subjects are more popular than mathematics, and probably, if the truth were known, more people are interested in it than in music; there are masses of chess players in every country and chess problems are "the hymn tunes of mathematics"; it pleases even men who have used disparaging language about it; and in this shameless pastime few could rival the author. "School", "Hogben", "repulsively ugly", "intolerably dull" are his synonyms for "trivial" in dealing with the less mystical parts of it. Of the other sort one gets the impression that their real place is neither a university, technical college nor art school, but a place of worship. Naturally he is a little more enthusiastic about "mathematical physics, a splendid subject with tremendous problems where the finest imaginations have run riot". As regards what he calls "atomic physics", before it fell among mathematicians it was called radioactivity, and was not altogether without a certain crude loveliness, as it sprang from chemistry, physics and geology, almost full grown. But since it entered the beauty-parlour of $\sqrt{-1}$—for the benefit of the unlearned, a talisman that generalizes gyration and getting there—its progress could scarcely be beaten by a young puppy chasing its own tail.

'Imaginary' universes are so much more beautiful than this stupidly constructed 'real' one, according to the author, and if by 'real' he means the Aunt Sallys stuck up and knocked down at successive annual science junketings in the attempt to get physical science into a mathematical strait-jacket, who would deny him? His chair as a collection of whirling electrons, for example, is not a little moth-eaten, for matter re-materialized long since, and is at the moment said to be mainly made up of neutrons. But the spectacle of science also and already beginning to grin through a horse-collar at itself in its vanity bag must have warmed, within their protective endowments, the mummified hearts of all Olympus' faded hierarchy. Most scientists, however, still believe that the saner outlook on Nature inaugurated by the experimental sciences does reveal the real universe, and that it is not stupidly constructed. Those of them duped by mathematical fantasy are to be put up with rather than pukkha'd.

But there would be a graver charge to answer if the defendant had not constituted himself counsel for his own prosecution, on the question of the relative harmlessness, beauty, utility and so on of trivial and make-believe mathematics. Counting and calculation are good servants, capable too, like art and music, of giving pleasure

[*] The student should make himself thoroughly familiar at an early stage with this simple method, known even in antiquity, of raising the second order of small quantities to Pukkha magnitude, as until proficiency is attained his progress will be laborious.

to those so minded as well as to professional performers; but in a world ruled by the counting-house rather than by physical and biological laws, they are bloody masters. The Hindu mathematicians, to whom we owe the first use of imaginary negative quantities, justified them by their analogy to debts. They had not then risen to the heights of being able to think in minus pigs. They used them simply to denote a diminishment of the number of positive pigs, which the then elementary conception of common sense demanded had first to be taken for granted. But they put into the hands of the eternal word-spinners a weapon able to falsify physical accountancy and send a scientific civilization off the rails. Yet this incredible little book is largely a homily on the purity and beauty of mathematical philosophy, which thanks itself it is not like common sciences, trivial mathematics, engineering and chemistry, being preserved by its very uselessness from the evil association of war. Make-believe mathematics has led to make-believe finance, and in relative destructive power the chemist's bomb is a squib by comparison with an imaginary quantity divorced from common sense.

The humble road surveyors who converted the abacus into a calculating machine, and the primitive mule-track into the *autobahn*, stuck up a mirror marking the end of it to assist them in their triangulations. They found it such an assistance that they failed completely to understand its danger to road-users or the necessity of putting up a warning sign. In time they became philosophers and roundly declared that what was behind the looking-glass was much more real than what was in front of it and that there "one at least of our nobler impulses could escape the dreary exile of the actual world". Now when a high-power civilization has crashed straight into it they congratulate themselves that theirs at least is "a harmless and innocent occupation".

This book is also in some way a repartee to Hogben's "Mathematics for the Million". For the benefit of those acquainted with neither, it may be said that Hogben, winnowing perhaps the only grain of truth in Marxism, sees in the social environment and needs the inseminator of mathematical discovery, whereas Hardy confesses, as if to a defect, that "there is no mathematician so pure that he feels no interest at all in the physical world, but in so far as he succumbs to it he is abandoning his purely mathematical position". More briefly the "real" mathematician is a religious maniac, and who can be expected to subscribe to the view that a religion, whatever it is, is "harmless"? Marxism certainly is not, and the only one approaching this one in its renunciation of the world is Buddhism. Under it, in India, the multitudes starve and swarm, a curious biological correlation, to which attention was directed by Adam Smith in the case of the poor Scottish crofters, but in India operating in a warmer climate. On the other hand, *our* efforts to subordinate physical to mathematical reality are at the moment taking a stormier course; but in the heat of conflict no one is likely to remember the proverb of the devil among the tailors.

Hardy's view that the motive of research is not conscious intention to benefit humanity, but intellectual curiosity, pride of craftsmanship and ambition will, of course, be generally endorsed in research circles; but it is not inconsistent with detachment having proved sterilizing and necessity stimulating, nor with the direction of discovery being dictated by the prevalent trend of social inquiry. But his paradox that the useful subjects are just those most useless to learn, "a little chemistry or physiology having no value at all in ordinary life", their utility being confined to their practice by the few who specialize in them, they themselves being educationally useless, is typical of the effects on education of any religion with its inverted order of sequence of body, mind and soul. If children had been taught at their mothers' knee they were primarily little internal combustion engines, which, scientifically fed and maintained, would in time develop mind and soul and beget other children, mathematicians and other magicians would not find it so easy to get across their slanders. Chemistry at least would have come into its own. Instead of making bombs it would be esteemed for its creative rather than destructive aspect. At present it is a mere butler to the 'real' philosopher, and jackal to the riotous imagination of the mirror-image of that king of beasts.

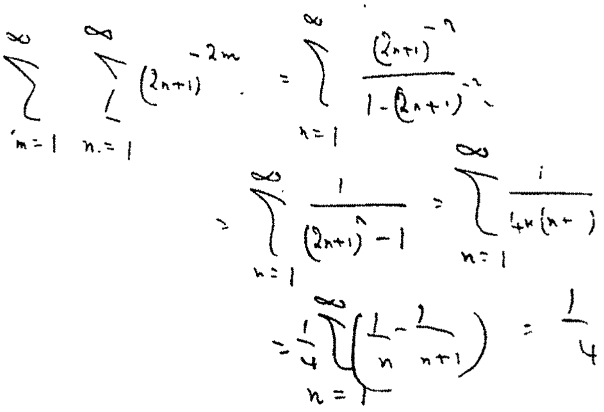
On this burning question of war, both Hardy, his critics whose criticism he thinks worth a special note at the end, and his opposite number are quite conventional. Hogben's "civilized people regarded war as a degenerate act of piracy" seems from a biologist and historian somewhat superficial, though it was written some years before the present struggle for existence started. But Hardy, in the midst of it, can write about "evil" chemistry without specifying whether by evil he means making good ammunition or bad. "When the world is mad, a man may find in mathematics an incomparable anodyne" has not apparently any reference to Archimedes. Surely in these times a little appreciation of the military virtues, rather than the conventional vilification of the profession of arms, is called for by religious people of all sorts, especially since their sort of "education" is really at the bottom of the whole tragedy, and the chemist's bombs and poison-gas are such a heaven-sent whipping boy for their own.

To the experimental scientist, Hardy's treatment of the nature of mathematical reality and his proof—from the primeness of a number—of it having external existence independent of the mind will be of interest. But as a guide he is as unreliable as the more popular exponents, and one gets the impression that outside his special subject—prime numbers—he can know little of it and cares less. He is merely a little more clever in concealing how the reader, usually by some pretty analogy, which no one could describe as mathematical, is made to take the false step himself. Thus we find before the proof from primeness, just alluded to, mathematical reality extended already to imaginary "geometries", the whole question at issue being begged by a footnote (p. 64. * "We must of course, for the purposes of this discussion, count as pure geometry what mathematicians call 'analytical' geometry"), leaving the reader to infer that he could prove the independent existence of mathematical reality as easily for a negative prime as for a positive one. Discussing the complete abstract generality of mathematical concepts, he follows Whitehead in saying they refer to "just any old things". Does that mean none ? For that is what *in practice* it has undoubtedly come to mean. But 317 nothings are the same mathematically as any other number of nothings or none. "It is obvious that irrationals are uninteresting to an engineer, since he is concerned only with approximations and all approximations are rational". As engineers deal with the measurement of continuous variables in the inanimate world, one would have thought it the other way, that they were interested in irrationals, as in this science integers and their ratio are positions without feature on a continuous line ending in a mirror, just as a biologist dealing with number for enumeration in the animate world has no use for fractions, rational or irrational.

In fact, the profounder the mathematician, when he reverts to everyday language, the less he seems able to talk it. They bore everyone to tears with their panegyrics over the profundity of the extension of the use of number from enumeration to calculation, which robbed them of any magic. They seem to treasure their most outstanding failures as remarkable achievements, and they impose on their wretched students a degree of formal rigour paralysing to the inventive capacity. Bertrand Russell's apocryphal dream, recorded in these pages, that he was in a university library about A.D. 2100 watching the assistant dumping all the old books off the shelves into a bucket and pausing a little over the last surviving copy of the "Principia Mathematica", is to-day at Oxford no dream but fact. But it is not the assistants—they weary of retrieving them from the cellars—it is prim and proper Prof. Hardy and his fellow purists, protecting the tender minds of their budding prodigies from loose thinking. They really should be barred from access to the shelves if their real purpose is to hunt out mathematical pornography. But there is a worse fate for a grand old mathematical text-book than the dump. It may be considered worth re-editing.

FREDERICK SODDY.

Postscript. The reviewer may have laid himself open to the retort that he has given no indication of what he considers real mathematics really is. As Huxley remarked, when you want to test the strength of a gymnast you do not ask him to lift a 200-lb. pair of dumbbells (such, for example, as is being dealt with in the hieroglyphics on the dust-sheet of this book, from "Asymptotic Formulæ in Combinatory Analysis" by G. H. Hardy and S. Ramanujan, which the publishers have thought the best way of frightening the public into buying it), but a 10-lb. Indian club *to see what he can do with it.*



$$\sum_{m=1}^{\infty}\sum_{n=1}^{\infty}(2n+1)^{-2m} = \sum_{n=1}^{\infty}\frac{(2n+1)^{-2}}{1-(2n+1)^{-2}} = \sum_{n=1}^{\infty}\frac{1}{(2n+1)^{2}-1} = \sum_{n=1}^{\infty}\frac{1}{4n(n+\ )} = \frac{1}{4}\sum_{n=1}^{\infty}\left(\frac{1}{n}-\frac{1}{n+1}\right) = \frac{1}{4}$$

On a glorious summer afternoon in 1931, misspent in a way for which even the author could scarcely apologize, attending a faculty meeting, to improve the anything but shining hour of imprisonment the reviewer slipped across a note to the author, demanding the sum of all the reciprocals of each of all the odd integers, except unity, raised to the power of each of all the even integers, a question which the veriest tyro must admit is scarcely up to scholarship standard. After a surprised and concentrated stare of disgust at this common and probably poisonous insect, he started jabbing it with a pencil, viciously but cautiously at first, then with lightning ferocity as he chased it down the paper to the kill, and *in an incredibly short space of time* flung back the dead body here reproduced.

F. S.

TREES OF MALAYA

Wayside Trees of Malaya
By E. J. H. Corner. Vol. I. Pp. vii + 770. Vol. 2. Pp. ii + 228 plates. (Singapore: Government Printing Office, 1940). 10 dollars.

IT is, we believe, unique to find monkeys co-operating with a botanist in collecting flowering and fruiting specimens of trees for botanical investigation. This, however, has been done in Malaya by Mr. Corner, the author of the very interesting book under review, and his trained Berok monkeys, one of which is figured on the cover of the book, have provided him with much valuable material which otherwise might have been unattainable.

Some 950 species of Malayan "wayside" trees are described, and keys are provided for running them down to their families and genera. Anyone, therefore, who is interested in the trees, and is not a botanist, should be able to determine them without much difficulty, more especially as the distinguishing characters selected can be readily observed and are available throughout the year. The book is greatly enhanced by more than 250 excellent illustrations of different trees, which comprise the second volume.

The first volume consists mainly of descriptions of the various trees, accompanied often by useful text figures of flowers, fruits, and leaves, and keys to the genera and species, and much interesting information is given about the trees and their uses, and also about the vegetation of Malaya.

The book, in addition, includes a descriptive account of trees and how to name them. Forty pages are occupied by the elaborate keys, which are constructed on somewhat original lines. Mr. Corner has, in some cases, sacrificed clearness and accuracy for the sake of brevity in his constant use of the words "not so" as the alternative phrase in the couplet of distinguishing characters. In the first place it is not always easy to appreciate to what it applies, and in many cases it certainly does not apply to the whole of the statement with which it is contrasted.

Another unusual feature of the book is the arrangement of the families and the genera in alphabetical order. This may serve a useful purpose, but it is very disturbing to the botanist, since it brings into juxtaposition families wholly unrelated to one another. The Gymnosperms, however, are relegated to the end of the volume.

The book is provided with excellent indexes of English, Malay, and Latin names, and the inclusion of derivations of the generic and specific names is very welcome.

The volumes are a credit to the Government Printing Office, Singapore. The printing of the text and the reproduction of the fine photographs leave nothing to be desired.

A. W. HILL.

AUSTRALIAN SHARKS AND RAYS

The Fishes of Australia.
Part I: The Sharks, Rays, Devil-Fish and other Primitive Fishes of Australia and New Zealand. By Gilbert Percy Whitley. (Australian Zoological Handbook). Pp. 280. (Sydney: Royal Zoological Society of New South Wales, 1940.) 7*s*. 6*d*.

THIS useful handbook deals, not only with the Selachians (sharks, rays and chimaeras) of the seas of Australia and New Zealand, but also with creatures such as the lancelets, lampreys and hagfishes, and the unique lung-fish of Queensland. It is complete in itself, but is designed to form the first of a series of volumes on the fishes of Australia, which, when complete, should go far towards providing a long-standing desideratum. Within the compass of some 160 pages, the author has managed to include a brief description and figure of every known species of shark and ray, together with notes on its local range, maximum size attained, and so on. It is perhaps to be regretted that keys are not provided to assist identification of specimens; but the excellence of most of the illustrations, based almost entirely upon authentic local specimens, should serve to compensate for this omission. There can be little doubt that the intelligent reader making use of the systematic section of this book should have very little difficulty in determining most of the fishes likely to come to hand.

In addition to the systematic part, however, Mr. Whitley has managed to bring together a mass of valuable information concerning sharks and rays in general, which is presented in a comprehensive and interesting manner in the first sixty-seven pages of his book. This covers not only the breeding habits, development, anatomy, teeth, food, and so on, but also more unusual subjects such as sharks in mythology, sharks in captivity, their commercial uses, and their attacks on man. The section dealing with shark attacks and tragedies is of special interest, although it makes grim reading. The correlation between the temperature of the sea, with the consequent popularity of swimming as a sport and the extension of the bathing season, and the liability of man to attacks from sharks is stressed, and the comparative rarity of such tragedies in the cooler waters of Britain explained.

The chief criticism of this book is concerned with its nomenclatorial features. The author's fondness for minute generic and subgeneric groupings, and for pouring endless new names into the already overburdened ichthyological synonymies, is well known, and has caused considerable concern to workers on fishes in all parts of the world. The more conservative reader will be more than a little puzzled by the names applied to familiar Australian sharks and rays. It will come as a shock, for example, to find the closely related species of spiny dogfishes, referred by most workers to the Linnæan genus Squalus, here designated *Flakeus megalops*, *Flakeus griffini*, *Koinga whitleyi*, *Koinga kirki*, etc. Again, the spotted dogfishes have been regarded by a distinguished European authority as constituting a single genus (Scyliorhinus), although others would be willing to recognize some four natural groups as genera: in the present work the Australian species alone bear six different generic names. The introduction of still more new specific, subgeneric and generic names in this book, which is admittedly of a semi-popular nature, is to be deprecated.

J. R. NORMAN.

METAPHYSICS REDISCOVERED

An Essay on Metaphysics

By R. G. Collingwood. (Philosophical Essays, Vol. 2.) Pp. x+354. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 18*s*. net.

IN this book Prof. Collingwood is trying not to redefine metaphysics but to define it truly. That is to say, he is setting himself the task of elucidating its essential nature—that by which it has had significance for every age in which it has flourished. His book is therefore an apology for metaphysics rather than for metaphysicians. Indeed, as is to be expected from its aim, it also provides an apology for what the author terms "progressive anti-metaphysics"; that is, the reaction experienced by living minds at any given time against the work produced by those professional thinkers who have the prescriptive right to be called metaphysicians, but who do not clearly understand their work. "It is only confusion as to what he is about," says the author, "that makes the metaphysician's work harder than that of other scientists" (p. 84). For metaphysics is essentially a historical science; and it is this aspect of its definition which is so liable to be forgotten.

The first part is concerned with the work of definition. Taking the metaphysic of Aristotle, the author shows that this reveals two possible definitions: (1) that metaphysics is the science of pure being; (2) that it is the science which deals with the absolute presuppositions underlying ordinary science. He disproves (1) on the ground that it is a contradiction in terms; for the universal of pure being is the limiting case of the abstractive process, while it is the function of a science to investigate the particular—a statement which may lead some philosophers to argue that, though undoubtedly true of modern science, it does not necessarily define science as the Greeks understood it; and that therefore the contradiction is convincing only if science is understood in the modern sense. Working on the second formula, the author goes on to a very valuable chapter on the nature of presuppositions, distinguishing between those which are relative and those which are absolute. Absolute presuppositions can never be answers to questions, because all questions involve some sort of presupposition. Hence the distinction of truth and falsity cannot apply to absolute presuppositions; that is, far from being propositions themselves, they form a condition necessary to all propositions. Going on to study the nature of absolute presuppositions, Prof. Collingwood comes to the inevitable conclusion that metaphysics is "the attempt to find out what absolute presuppositions have been made by this or that person or group of persons, on this or that occasion or group of occasions, in the course of this or that piece of thinking" (p. 47). It is its nature as a ***historical*** science which decisively differentiates metaphysics from theology. Theology sets out presuppositions which are to be accepted by faith: metaphysics studies historically those presuppositions which are in fact accepted in each successive era of thought. As regards the immunity of their subject-matter from examination as to its truth or falsity, each agrees.

The second part of Prof. Collingwood's book is concerned with anti-metaphysics and pseudo-metaphysics. Anti-metaphysics may be progressive, reactionary, or irrationalist ; and pseudo-metaphysics confuses absolute with relative presuppositions. In the light of these distinctions, psychology is considered as anti-metaphysics and as the pseudo-science of thought ; but it is a pity that Prof. Collingwood, in common with most philosophers, judges the present science by its philosophical antecedents, while it is a characteristic of modern psychology that those antecedents are nominal only. Is not the author here falling into one of the very pitfalls which he has hitherto stated to be a source of confusion to metaphysicians ? Many psychologists certainly fall under the heading of anti-metaphysicians—but *progressive* anti-metaphysicians. Is it not the task of the metaphysician to examine the presuppositions of psychology as it stands to-day, rather than to judge it in the light of outworn definitions and a misleading heredity ?

The third part of the book under notice is devoted to examples and illustrations based on the ideas of the first two parts. For example, there is an examination of the relationship between the European "scientific frame of mind" and its religious institutions, which, says Prof. Collingwood, are the guardians of the presuppositions upon which it has flourished. The latter part of the book is devoted to an examination of the philosophy of Kant, and an analysis of the idea of causation.

It is a characteristic of living works that they themselves are illustrations of the principles which they express in words. This is eminently true of Prof. Collingwood's very stimulating book. In his own words, "for a man of the twentieth century it is inexcusable to take a metaphysician's word for what he is doing. You must settle that question yourself by studying his works" (p. 235). It is not therefore surprising to find here illustrated the difficulties which beset the twentieth century metaphysician faced with the problem of modern psychology.

B. M. BALDWIN.

WORLD HISTORY

The Golden Ages of History
By Joseph McCabe. Pp. xi+242. (London: Watts and Co., Ltd., 1940). 10*s*. 6*d*. net.

IT is surely rather a mistake to use the term 'Golden Ages' as if it had any generally accepted or scientific meaning. It is rather like so many of the current slang words about an airman's achievements. Something or somebody strikes the speaker as exceptionally good, and he uses the phrase to characterize fifty or a hundred years of history or a long and exciting flight. In this way Louis XIV managed to gild some hundred years of French history, Queen Victoria not quite so much, and Queen Elizabeth still less. There is thus a profound fallacy in comparing or using the same terms of Queen Elizabeth's reign and the hundreds of years of China's flowering under the Tang and other emperors. Readers will also be inclined to jib at the exalted position assigned to the last hundred years of European history, considering that it includes at least five periods of disastrous fighting, and that it has culminated in the present War, which leaves us in grave doubt as to how much of Mr. McCabe's quite justly lauded triumph of science will survive.

These faults or queries about the book will strike every reader as soon as he opens it. But it would be a grave mistake to discard the wisdom which is often intermingled with the author's fallacies and prejudices. In the first place, it is a useful thing to have in one compact volume the mass of historical facts concealed in learned tomes, and to have them spread out chronologically, even if not in equal measure. British people are shockingly ignorant of history as a whole. It takes a war like the present to arouse us to a sense of our own historical greatness, and much of Mr. McCabe's book is entirely unknown, even to schools or scholars who 'do well' or are 'keen about their history'. It is a ridiculous and quite unnecessary fault in our school curricula which derives from the medieval fact that history was regarded merely as the chronicle of kings and popes down to nearly five or six hundred years ago. Summaries or conspectuses of the whole were always wanted, just as a globe has always been a necessary part of every school's equipment. Here is the place for such books as that of Mr. McCabe and of Mr. H. G. Wells. We would only plead—and every teacher will agree—that the 'book-globe' of history should be freer from prejudice, should aim at a simpler and less highly coloured picture than Mr. McCabe gives.

One might be allowed to suggest two or three of the essential features of such a 'general history'. It should be comprehensive, as Mr. McCabe has tried to make his. There is no acceptable reason why the outlines of Chinese or Indian history should be completely ignored. But it may be fairly at the same time rather more Western than Eastern, considering that, in the main, Westerners will read it, and that Western methods of government and education continue to spread over the world. Then there are two points on which I am happy to agree entirely with Mr. McCabe. The first is that our view of history from the first should cover all classes, and not the eminent or wealthy who fill the larger place in the older books. This does not mean that art or beautiful things should be ignored, but that they should be regarded as part of the patrimony of the poor as well as of the rich. The second, and perhaps most important of all the aspects of history, is the growth of knowledge and the use of knowledge for the welfare of mankind. On this point Mr. McCabe is sound and strong. What he needs is a kindlier and truer realization of the place of religion in history, and the value of religion to the poor as well as the aspiring, both in the East and the West.

F. S. MARVIN.

FROM COUNTING TO THE CONTINUUM

Number: the Language of Science
By Prof. Tobias Dantzig. Second revised and enlarged edition, based on the third American edition. Pp. xi+320+11 plates. (London: George Allen and Unwin, Ltd., 1940). 10*s*. net.

PROF. DANTZIG'S title raised my hopes. As a biometrician concerned in an attempt to substitute mathematical expressions for such useful, if slightly vague, biological expressions as race, type, heredity, and variation, I hoped that he might show why science is inevitably and progressively doomed to use mathematics as its language. He might even furnish me with arguments to be used on my non-mathematical colleagues.

I was disappointed. The book is written from a historical angle, and shows how the concept of number grew from the stage of finger-counting to transcendental and complex finite numbers, and transfinite cardinals. Practically nothing is said of further generalizations such as vectors and Kronecker ideals, though the former at least have more place in the language of science than transfinite cardinals.

The historical survey is full of interesting quotapions, and illustrated by an excellent series of portraits, but it is somewhat over-simplified. Thus, on p. 30 we read that the Greeks did not create even a rudimentary algebra, and that positional numeration originated in India. This enables the author to evade the very interesting questions of why Diophantus's algebra remained rudimentary, and why the Babylonians, who used positional numeration to some extent, did not invent zero or the decimal point.

The account of Cantor's work is particularly clear. But the same cannot be said for the treatment of mathematical reasoning. On p. 66 we read that a conclusion is logically flawless, if "we have examined our premises and found them free from contradictions". Surely a less acquaintance than Prof. Dantzig's with the history of mathematics should have made him pause before he wrote this sentence. For two thousand years Euclid's axioms were supposed to be free from contradictions. But Prof. Dantzig's Chapter xi on transfinite numbers is full of awful warnings against pushing the assertion that the whole exceeds the part beyond its proper domain; and quite recently Gödel has shown that no system of axioms can be proved to be free from contradictions. It can be tested for hidden contradictions, but a failure to find them is no proof that it is logically flawless.

This book has its proper place, in the library of amateurs of mathematics, or of schoolmasters who wish to make elementary mathematics as interesting as possible. But it does not tell us why in some periods mathematics develops in response to the demands of science, and at other times independently. Thus, the first transcendental functions were invented because observations became sufficiently accurate to make them valuable. Then function theory ran ahead of practice. To-day science has caught up mathematics in many fields, and unfortunate biologists like Sewall Wright and myself are compelled to investigate probability distributions (one of the most interesting generalizations of number) because the mathematicians have not yet done the work for us.

Prof. Hogben, to take a recent and justifiably well-known example, has told us how mathematics grew up in response to scientific demands. Prof. Dantzig tells us something of how it grew under the stimulus of its own internal contradictions. I am waiting for an author who will combine these two points of view, and give us a real philosophy of mathematical progress; and I hope that when such a book is written it will be better bound than "Number".

J. B. S. HALDANE.

The Commissioning of Electrical Plant and Associated Problems

By R. C. H. Richardson. (Monographs on Electrical Engineering, Vol. 5.) Pp. xvi+363. (London: Chapman and Hall, Ltd., 1938.) 21*s.* net.

ENGINEERS on the whole do not exhibit reticence when recounting difficulties they may have experienced during the commissioning of electrical machinery and plant; but when it comes to publishing such an account, even if time and circumstances permit, the greater the diversity and interest of these experiences the less are they likely to appear in print. It is not surprising that this dearth of literature leads to expectations being aroused, perhaps unduly, if at last what appears to be a record of personal experiences is published.

The book under review gives rise to a reaction which is one of disappointment, for it is distinctly lacking both as regards personal appeal and the recording of instances of the surmounting of 'teething troubles'. In the first place, someone ought to have persuaded the author to discard elementary theory, such as the derivation of the equivalent circuit of a transformer or the elementary theory of vectors, which is to be found in so many existing text-books, and utilize the space thus gained for more meaty matter. Not a few cases of trouble from 'noise' have been encountered when commissioning transformers; yet, in this book, noise does not figure in the index or in the text. The vibration and noise of machinery, it is true, are mentioned on p. 84, but methods of measurement, treatment or cure are not described.

Mathematical treatment has been avoided, but at a price, for instead of being an advanced treatise the book is largely descriptive though lacking photographic illustrations. The text is supported by numerous line diagrams and there is a short bibliography, but it is considered that the list of books given is totally inadequate. Such a serious trouble as that of 'hunting' is not dealt with in the section on alternators and is not referred to in the bibliography.

In favour of the book it may be said that it would serve to guide a reader to the many matters which he may have to study deeply if he is to have confidence in commissioning machinery and plant.

Psychology, Psychotherapy and Evangelicalism

By Prof. J. G. McKenzie. Pp. xiii+238. (London: George Allen and Unwin, Ltd., 1940.) 10*s.* 6*d.* net.

PSYCHO-THERAPEUTIC techniques provide new means for a study of the various types of religious experience, and Prof. McKenzie applies them to the study of Evangelicalism. For examining it he has the important qualification of having shared in the evangelical experience himself. Evangelical Christianity has suffered much from the dramatizing tendencies of its exponents; they have laboured to heighten the vividness of the colour scheme, and the result has been that they have presented the world with something fantastic. The actual facts are more sober. Not all evangelicals are of the 'twice-born' type, nor does the root and centre of their religious experience invariably lie in mystical states of consciousness. Anxious to induce in their converts a conviction of sin, evangelical teachers have sought to deepen their sense of guilt. Prof. McKenzie writes at length and with great insight upon this point, making a clear distinction between "the true sense of sin which involves repentance, and the sense of guilt which is always the outcome of repression and must be removed before repentance and forgiveness can take place". He holds that the well-meant attempt to deepen the sense of guilt "not only does damage to the personality but is a hindrance to evangelical Christianity".

In a most interesting section on "The Meaning of Sin", Prof. McKenzie makes a distinction between "two absolutely different types of personality": the "Ego-centred" and the "Object-centred". The former "makes himself his own main purpose", consciously or unconsciously. The popular notion that virtue consists in "the integration of the personality" is not accepted by the author, for "This integration is not a moral process in itself". The quality of the integrated self depends "on what moral principle has integrated it". Prof. McKenzie has a most illuminating section upon forgiveness; and indeed his book as a whole is so full of valuable material that it will repay study not only by psychologists but also by theologians and ministers of religion. J. C. H.

A Pocket Medical Dictionary

Compiled by Lois Oakes, assisted by Thos. B. Davie. Fourth edition. Pp. xx+409. (Edinburgh: E. and S. Livingstone, 1940.) 3*s.* 6*d.* net.

THE distinctive features of this popular little book, the modest price of which makes it specially suitable for medical students and nurses, are the addition of many new words and the deletion of those no longer current, an appendix on first aid, and an anatomical chart of the human body. We have noticed only one serious mistake, namely, "rotheln" (without an *umlaut*) stated to be the same as "measles", while the following words should be inserted in the next edition: "barbiturates", "erysipeloid", "erythema infectiosum", "fourth disease" and "tularæmia".

Diathermie chirurgicale

Par Dr. C. A. Arraud. (Les actualités physiothérapiques, 1: Électrothérapie, 7). Pp. iv+216. (Paris: Gauthier-Villars, 1939.) 50 francs.

THIS clear and concise little work by Dr. C. A. Arraud, assistant in physiotherapy at the Hôtel Dieu, Paris, is divided into two main parts. In the first, which is introductory, the author deals with the historical aspects of surgical diathermy, the various currents employed, and the choice of an apparatus, particularly those of French origin. The second part is concerned with the employment of surgical diathermy in cancer and in disorders of various systems, such as diseases of the skin, gynæcology, urology, diseases of the alimentary system, neurology, respiratory diseases, otorhinolaryngology and ophthalmology.

The Grasses of Mauritius and Rodriguez

By C. E. Hubbard and Dr. R. E. Vaughan. Pp. 128. (Mauritius: Director of Agriculture; London: The Crown Agents for the Colonies, 1940). 4*s*. 6*d*.; 3 rupees.

MAURITIUS and Rodriguez, alas, so far as their native vegetation is concerned, afford sad examples of the results of human activity in developing a country for its economic possibilities. Sugar cane cultivation and plantations of other exotics have changed the face of the islands with the result that, in place of the original forests of indigenous trees, scrubs and thickets now occupy much of the ground not devoted to plantations. In this change the native grasses have naturally suffered, and many exotic ones have been introduced, and, as is so often the case, have tended to oust the native species, so that, except by studying carefully the habitat of a particular species and its distribution in the island, it is by no means easy to say whether a particular genus or species is a native or not. Seven endemic species are known, but they may not now all exist. Interesting particulars of the indigenous grasses are given in the introduction, and full descriptions, with useful figures of some of them, form the bulk of this useful volume. Excellent keys to the tribes and genera precede the descriptions, and notes are given on the economic uses of the native grasses. There is also an account of the structure and classification of grasses with good text-figures, which should enable anyone to become familiar with the structure of the grass flower and the points used in describing and classifying the genera and species.

The preparation of this account is a valuable piece of co-operative work by the field botanist, with an extensive knowledge of the ecological conditions in Mauritius and Rodriguez, and the herbarium botanist, who has made a critical examination of the specimens, and from his extensive knowledge of the world's grasses has been able to determine which may be indigenous and which introduced.

Since it is becoming necessary to convert waste areas, now dominated by scrub, into grazing lands and pastures, an exact knowledge of the grasses which occur in the islands and of their economic value is most desirable.

The authors are to be congratulated in having produced so useful a piece of work, and also the Government of Mauritius for their wisdom in making its preparation possible, both by their encouragement and by a grant towards its publication.

A. W. H.

Elektrische Höchstspannungen

Von Dr. A. Bouwers. (Technische Physik in Einzeldarstellungen, herausgegeben von W. Meissner und G. Holst, Band 1.) Pp. ix+344. (Berlin: Julius Springer, 1939.) 31.20 gold marks.

THIS book is highly recommended to anyone interested in the technique of high-voltage or high-frequency apparatus and testing, or who is seeking a comprehensive outline of current practice in this rapidly developing branch of electrical technology. It is very well illustrated with 239 explanatory diagrams and photographic reproductions of actual apparatus of recent construction. There is a valuable bibliography, containing 324 references, and an excellent index.

The opening sections are devoted to the theory of high-voltage transformers, cascade connexions, high-frequency transformers, coupled circuits and surge generators, with illustrations from American and Continental practice. The Van de Graaff generator, the cyclotron and apparatus for "Der Blitz" are described. Parts 2 and 3 deal with the theory of electric fields, associated with this class of apparatus, and insulating media respectively, and are supported by good illustrations of modern terminal constructions, bushings and condensers. Valve generators of the Marx and other types are described in Part 4, and the remaining two sections of the book outline, in brief, methods and apparatus for measurements, rectifier tubes, auxiliary apparatus, feeder-circuits and their lay-out for radiography. The latter portion of the book rather tails off, so that it cannot be recommended as a treatise for radiographic technology. The printing and general production of the book leaves nothing to be desired, but its price is excessive.

Concise General Astronomy

By the Rev. O. R. Walkey and Dr. H. Subramania Aiyar. Pp. vii+442+8 plates. (Trivandrum: Sridhra Printing House, 1940.) n.p.

A FOREWORD in this book has been written by Sachivottama Sir C. P. Ramaswami Aiyar, Dewan of Travancore and Vice-Chancellor of the University of Travancore. It is claimed in this foreword that the work deals adequately though briefly with the new concepts as to space, time and relativity—a claim which is justified in spite of the fact that mathematical formulæ are practically omitted. Much important up-to-date information has been included in the text, and an excellent index greatly enhances the value of the book. The appendixes and tables—twenty-five altogether—supply a large amount of useful material in a very concise form on various astronomical matters; some of these deal with Hindu astronomy and show how extensive was the Hindu knowledge of the subject. The work will fulfil its author's aim, "to rouse an intelligent interest in the sublime but generally ignored subject of Astronomy".

Hilfsbuch für das Sammeln und Präparieren der niederen Kryptogamen

Von Prof. Dr. Gustav Lindau. Zweite, neubearbeitete Auflage, von Prof. Dr. O. C. Schmidt. Pp. vii+93. (Berlin: Gebrüder Borntraeger, 1938.) 3.60 gold marks.

IN this useful little handbook, now in its second edition, an account is given of the methods to be employed in the collection and preparation, for herbaria and for subsequent examination, of the lower Cryptogams, sections being devoted to the special requirements of terrestrial, freshwater and marine algæ, myxomycetes, fungi, lichens, mosses and liverworts.

A REMARKABLE PAINTED CAVE ON THE ESTATE OF LESCAUX (MONTIGNAC, DORDOGNE)

By PROF. THE ABBÉ HENRI BREUIL

COLLÈGE DE FRANCE

IN mid-September 1940, several young lads of Montignac, MM. Ravitat, Marsal, Quéroy, Cuëncas, and Estrégil, encouraged by a retired schoolmaster of the town, M. Laval, to explore underground passages in the neighbourhood, cleared out a shaft leading vertically from a plateau to the east of the town. This shaft had been filled up to prevent cattle falling in and only a narrow passage led to the bottom, ending in a hollow into which the young explorers slid after having enlarged it. Descending a slope of fallen boulders, they discovered that some of those fallen from the vault of the first hall were decorated with magnificent frescoes which continued down a narrow alley leading out of it. M. Estrégil made several sketches of these, which he showed to M. Laval, who was at first sceptical about them. Whereupon M. Maurice Thaon, a good sportsman and draughtsman, whom I had known since his childhood, and to whom, a few days earlier, I had shown the painted caves of Font-de-Gaume and La Mouthe, at Les Eyzies, was taken to the cave by the youthful discoverers, and brought careful drawings and some tracings to me.

His descriptions convinced me of the exceptional importance of the discovery. I therefore went to Montignac, where M. Laval, M. Parvan, bailiff of the proprietor, Madame la Comtesse Emm. de la Rochefoucault, and various distinguished people received me most kindly. I asked M. D. Peyrony, delegate of the Ministry of Fine Arts, to meet me there, and a three days' study enabled me to send a preliminary report to the Académie.

The cave in its present state consists of an oval entrance hall (20 m. × 10 m.) continuing in a narrow passage. In the second half of the hall and in the passage there are more than eighty paintings, chiefly on blocks fallen from the vault above. In a short gallery to the right, there are fewer ; but this gallery leads to another lofty hall sloping steeply and leading on the left to a corridor with a high nave, shrinking to a slit of a passage, extremely narrow in parts.

Beyond the lofty hall is a well about 10 m. deep leading by a scramble on the opposite side to ascending galleries, as yet almost unexplored. In the high nave, engravings are generally superposed on paintings ; but they are unaccompanied in the tortuous galleries ; their great number and delicacy have prevented us from deciphering them adequately, as yet.

The paintings vary in size from 30 cm. to nearly 5 m. ; they are of different technique, frequently superposed and restored.

(1) A single little hand outlined in red, with its arm, recalls the Aurignacian type of hands.

(2) Fine line drawings in red, of horses and stags.

(3) Bigger red line drawings, wide blotchy lines filled in with splashes here and there, representing a fairly big horse and bison ; there are also some big bulls and stags covered over and swallowed up by other figures.

(4) Small and medium-sized red, black or sepia line drawings, or in a mixture of these tints more or less filled in with rather transparent sepia or red very much stomped spots. Black touches have often been added later, blending and denoting anatomical details or restoring the outline. A great many small horses, often with very heavy coats, and a great many stags, their antlers in twisted perspective, and one bear (?)

(5) Figures in red, medium-sized, softly dappled, being horses and oxen with small horns and slender build.

(6) Black wash combined with dappling, frequently used in restoration, or depicting single analogous animals.

(7) Two ibex, decorated with wide splotchy black bars.

(8) Stag's heads drawn with a fine black line.

(9) Enormous bulls with big horns, the biggest about 5 m. long, drawn in wide black lines, the colour spreading over the legs and horns and part of the head, the field inside the outline sprinkled with big spots, though usually only the head.

There are neither reindeer nor mammoth, and besides the animal figures there are a good many signs ; rectangles barred lengthwise and across ; five-pronged comb-shaped signs, chessboard patterns filled with big squares of flat wash, the colours arranged in varied ways, looking like coats of arms; lances or javelins with a single barb; arrows, feathered on one side.

The foot of the well boasts a more unusual subject; to the left a black rhinoceros walks slowly away; in the centre, drawn in red, a half-conventionalized man is lying beside a javelin and a throwing stick. To the right, a sand-coloured bison outlined in black gazes at him; its entrails seem to be flowing out like a horse ripped open in a bull-fight. It looks like a scene in a prehistoric drama. Near the man a bird is perched on a post.

Though there may be many surprises in store when the engravings are studied, we can state already there are many horses, oxen, bison, two lions, and what seem like straw huts such as those at Altamira.

As regards the age of the engravings and paintings at Lescaux, the following are some suggestions.

In Dordogne, there are such blocks fallen on the hearths found in the Aurignacian levels and during the Perigordian epoch, in the rock shelters of Blanchard and Labattut (Sergeac) discovered by Monsieur Louis Didon. These blocks display big bichrome figures or the last of the black line drawings. This discovery permitted me to date as of pre-Solutrean age a few figures partially hidden under the big polychromes and black shaded paintings of Magdalenian age at Font de Gaume (Les Eyzies), Le Portel (Ariège) and Cabrerets (Lot), all of which have fine painted panels of that age. It is the same in the Cantabrian provinces; the beautiful Magdalenian frescoes of Altamira are obliterated by red line and red wash drawings, between these two black line drawings intrude.

At Cavalanes and La Haza there are only paintings in wide smudgy red lines, but at La Pasiega such paintings obliterate fine line drawings and have black drawings superposed. The stags and oxen of this ancient series have horns in twisted perspective as at Lescaux, and we have already remarked that this curious perspective is always seen in the open air art of the east of Spain from Lerida to Almeria. The only French examples are those in the rock shelter of Labattut (Sergeac) and the two at Portel (Ariège).

The similarity of the stags and oxen at Lescaux and those in the eastern Spanish art is sometimes so great that they become identical. M. Peyrony and I agree that the whole ensemble of Lescaux represents an art earlier than either the Magdalenian or Solutrean, and except in a few instances is attributable to levels later than the typical Aurignacian. As the much regretted Joseph Déchelette called Altamira "the Sixtine Chapel of Magdalenian art", so Lescaux represents with equal splendour that of the far more ancient Perigordian.

SEARCH FOR PETROLEUM IN AUSTRALIA

By H. B. Milner

SIR EDMUND TEALE'S recent observations on oil occurrences in Gippsland, Eastern Victoria (a summary of which appears on p. 27 of this issue), reopen in critical circumstances two fundamental though wider questions: if there exist *commercial* petroleum reserves in the Commonwealth of Australia, where are they and why have they not long since been exploited ? Now, if ever, is surely the time to realize such assets if they are not for ever to remain frozen.

For many years past, indeed, and since before the War of 1914–18, both casual and ordered search for oil pools in this continent have occupied the attention of pioneers, mining engineers, State, Territorial and Commonwealth Government Departments, also leading oil companies. The record is long, interesting, but in results bitterly disappointing. Even so, belief in possibilities still prevails in many quarters, fostered perhaps more by political and economic than by scientific premises. Let us first briefly review geological data.

The relationship of loci of major oilfields of the Eurasian continent to the Alpine geotectonic system is a firmly established and universally recognized fact. To take the relevant segment in terms of petroleum development, follow through Irak, Iran, North-West India, Assam, Burma, Dutch East Indies to New Guinea: these proved fields in disposition themselves trace those great Tertiary earth-movements responsible for their actual oil concentrations to-day. But equally the fundamentally resistant earth masses to the south, namely, Arabia, peninsular India and, be it noted, Australia, played a significant, if passive, part in restricting the influence of this diastrophism, being themselves practically unruffled in the process.

Thus any oil pools existing in Australia must at least lack the Alpine *cachet*, surely a most serious disadvantage in that part of the globe which even the pernicious habit of wishful thinking cannot entirely overlook. In point of fact, structures impressed on these relatively static earth-masses tend to be epeirogenic and inimical to oil accumulation, even if the requisite mother-substance of petroleum is present in otherwise suitable sediments: witness the Tertiary deposits of Gippsland, almost entirely undisturbed in the sense we understand Iranian or Indo-Burman folding. Although this is all uninspiring re-statement of fact, it is surprising how often and how persistently it has been and still is disregarded.

Frankly, we must recognize that a large part of Australian territory is geologically unfavourable to localized petroleum segregation, especially in West, South Australia and Northern Territory. A fundamental Archæan and Proterozoic complex, counterpart of peninsular India, South Africa and Madagascar, constitutes not only the foundation but also much of the surface geology of this continent. Widespread developments of Palæozoic sediments sterile of oil, masses of Mesozoic epicontinental deposits, relatively undisturbed Tertiary rocks often obscured by thick Quaternary drift, a not inconsiderable development of oil shale in certain regions and an almost total absence of surface indications of petroleum throughout the continent, are basic factors to be contended with in any assessment of oil possibilities.

Even those districts offering some degree of encouragement in the past, for example, Central and Southern Queensland, Victoria, the Victoria – South Australia borderland and some tracts in Western Australia, if pertinently reviewed in proper perspective, fail, at least in my opinion, to raise much enthusiasm either now or for the future.

In Queensland, at Longreach, several boreholes put down for artesian water encountered hydrocarbon gases, small oil flows and mineral wax. Wells in the Permian at Hutton Creek and Arcadia found gas, though often supercharged with carbon dioxide. Work has recently been resumed at these places and deep tests have proved 'wet' gas. Natural gas at Roma, Southern Queensland, has been known for forty years or more, and associated light oil distillates have been refined and marketed on and off since 1927. More recent drilling at Mount Basset near Roma revealed only traces of oil and gas. So in spite of widespread exploration in this area over a protracted period of time, no main oil pool has yet been located, and subsurface conditions, so far as they are known at present, do not give grounds for hope that anything spectacular lies ahead of further developments, however extensive and far flung they may be.

Tests in New South Wales, for example, Kulnura and Mulgoa, produced negative results. Search has been carried out in the Hunter River Coal Basin, also in the extensive Mesozoic deposits of south-east Queensland and north-east New South Wales, again inconclusively. It would appear that the 'oil shales' (boghead) of the Coal Measures in this State provide a clue to prevailing hydrocarbon conditions, and petroleum, if present, is nothing more than an elusive, sporadic trickle. In the former connexion it should be mentioned that intensive development of the established oil-shale field at Glen Davis, Newnes, is, according to reports received early this year, proceeding on the basis of anticipated production of 10 million gallons of shale-oil per annum, believed capable of expansion to 30 million gallons if adequate Federal subsidy is forthcoming. If such development fulfils early hopes, then this source of fuel must necessarily be of the greatest possible importance to the Commonwealth in present circumstances, especially for the Navy and in the general scheme of national defence.

Eastern Victoria boasts the only producing oil wells in the Commonwealth, at Lakes Entrance, Gippsland district. Since discovery in 1924, an emulsified oil has been obtained from which in latter years an *annual* production of some 25,000 gallons (!) has been recovered. Association of oil with prolific artesian water is scarcely a healthy sign, although the Imray borehole indicated that oil and water sands were separated. The trouble with Lakes Entrance is that there is no natural pressure to cause flow of oil to the wells when the sands are penetrated; hence commercial production is impracticable either by drilling or pumping. It would appear to be equally impracticable to use the underlying water to flush out the oil. Some system of air repressuring might be tried as suggested by Sir Edmund Teale, but to do this satisfactorily means effective plugging of all producing and shut-down wells, to say nothing of a financial outlay of considerable dimensions.

Although it has been reported that some 150 million gallons of oil are available here, even if economically recovered, no petrol or fractions lighter than lubricating oil could apparently be refined from it. Is such an enterprise worth while even as a war-time measure? If there is a doubt about it now, how much more hazardous would be the project in peace-time. Sir Edmund makes out a good case for speedy consideration and action by Government and other interests concerned, but even so the chances of success are not impressive. Apart from Lakes Entrance, recent drilling activities at Lake Boga, Portland, and at Nelson came to naught, while another enterprise at Dutson showed no sign of oil or gas.

In the South Australia – Victoria borderland country, the Tertiary deposits are alleged to contain some oil, but it is probably widely dispersed. Oil seepages reported from Glenelg River when followed up led to nothing. Prospecting carried out in this region seems to have been inspired by a widespread occurrence of bitumen along the whole southern coast of the continent, quite probably washed up by prevalent Antarctic tides.

In the Kimberley region of North-West Australia trials for oil were made at Nerrima, south-east of Broome, in 1939, but no oil or gas shows of consequence were encountered. Again, in his report on petroleum prospects of the Kimberley district of Western Australia and Northern Territory, made more than sixteen years ago, Dr. A. Wade wrote: ". . . the area could not have been less favourable from the point of view of prospecting for, or for the finding of, petroleum supplies. It is more suited to the prospector for gold and other minerals . . ." One cannot escape the feeling that this last remark applies to a far larger part of the continent than many people realize.

THE RUBBER RESEARCH INSTITUTE OF MALAYA

BY SIR GEOFFREY EVANS, C.I.E.,
ROYAL BOTANIC GARDENS, KEW

ABOUT ninety per cent of the rubber in the world is manufactured from the latex of the tropical tree *Hevea Braziliensis*, a native of the Amazon region of South America, but now cultivated on a plantation scale in Malaya, the Netherland Indies and Ceylon, which areas produce practically all the rubber of commerce. The story of how Sir Henry Wickham managed to secure seeds of this wild tree from Brazil in 1876, and its subsequent transfer, via Kew, to the Peredeniya Gardens in Ceylon, and thence to Malaya and the East Indies, is a fascinating one. Some of the original trees are still growing at Peredeniya. From these small beginnings, the vast plantations of the Far East have their inception. In Malaya alone the area under rubber amounted to more than three and a quarter million acres in 1937, and the exports to nearly 500,000 tons, valued at nearly 350 million Straits Settlement dollars.

The industry made enormous growth at the start; but like so many other plantation industries, it had, at a later stage, to face obstacles in the shape of lower prices and fluctuating markets following periods of over-production. The earlier planters merely cleared the forests and planted rubber and were content to collect the produce without devoting much attention to the methods of cultivation. In this respect rubber presented no difference from many other tropical plantation crops. A period of boom prices would result in the wholesale planting of areas, irrespective of soil and climatic conditions, but subsequent slumps, combined with acute competition, brought home to those interested in the industry the vital need for research and for control in the output. With the ramifications of the rubber restriction proceedings we are not concerned; but the progress of the research work is a subject worthy of more than passing note, in view of the thorough manner in which the need has been met.

In the years immediately succeeding the War of 1914–18, the pros and cons of the matter were thoroughly thrashed out by those vitally interested in the commodity, both in London and in Malaya, and their views crystallized into the idea that a research station was needed, which would be in a position to tackle the various problems that beset the industry. The problems were many. There was first the system of cultivation. It had been considered from the first that clean weeding was essential to the successful growth of the rubber tree; but tentative experiments made by the Agricultural Department had indicated that this system was not necessarily the best, and that it resulted in the loss of much soil through erosion. Sir Lewis Fermor, in a recent report on the mining industry of Malaya, hinted that possibly as much erosion had been caused by rubber planting as by tin mining operations, which had always hitherto been blamed. Nowadays one hastens to explain this is not the case, as cover crops are the usual practice on rubber estates and clean weeding has been abandoned, and with it much erosion has been checked.

The Rubber Research Institute of Malaya was at length organized and started work in September 1926, and, after the usual teething troubles which seem to be inevitable with institutions of this nature, it can now be considered to have fairly got into its stride. A study of the annual report for 1939 gives full indication of this, and a perusal of the 277 pages will convince readers of the thorough way in which diverse and complex problems are being investigated.

The Institute is situated near Kuala Lumpur on a suitable site and is well equipped with a competent staff and excellent laboratories and land for experimental work. The scientific work is organized into several divisions dealing with botanical, soils and fertilizers, technological and pathological problems ; there are also an experimental station of 1,850 acres at which work on cultural matters is investigated and experimental field plots laid out. In addition, there is much advisory work which preserves contact with the planters throughout the area. Close co-operation is maintained with the Rubber Research Scheme of Ceylon, with the London Advisory Committee, and other scientific institutions in Great Britain, and with the British Rubber Producers Research Association. This latter body is a part of the International Rubber Research Board, and by this means close liaison has been established with other research workers in Java and elsewhere.

In the Soils Division much has been accomplished in examining the various types of soil that occur in the peninsula with regard to their suitability for rubber growing and in ascertaining the manurial requirement for each type. Erosion problems are being examined, and the various systems of establishing new plantings by the relative methods of no burning versus light or normal burning are being tested. Whilst clean cultivation has now been abandoned, it has been found in practice that the establishment of permanent cover crops is not an easy matter on certain types of soil and are certainly difficult to maintain under mature rubber. Experiments in inoculation and manuring are, therefore, being made to try to get over the difficulty.

Valuable work by the Botanical Division has been done in the provision of improved planting material. The percentage of acreage replanted with higher yielding material is still considerably less than that of Java, as the Netherlands Indies started work of this nature several years before Malaya. Much progress has now been made in selecting high-yielding trees for bud wood, the number of high-yielding clones that have been tested and approved shows annual progress and the demand for the material is greater than the supply. The stage has now been reached when the yield from the present best proved clones is unlikely to be exceeded by selection from further high-yielding trees ; resort is accordingly being made to pollination between high-yielding clones, and some of the seedling clones resulting are stated to be of high promise. Further valuable work by this division is being undertaken in testing different kinds of tapping systems, in the use of growth-promoting substances in the vegetative propagation of Hevea, and in stock-scion relationships. An interesting piece of work from which good results are expected, is in studies of the nutrition of the plant and also the connexion between leaf symptoms and various deficiencies.

The Pathological Division deals with pests and diseases. One of the chief troubles in newly planted areas is the control of root disease. Control of old stumps which are the focal points of the disease seems to be best assured by the use of sodium arsenite. An interesting piece of work is in the testing of nodule bacteria in connexion with the growth of cover crops, such as Pueraria and Centrosema, which, as mentioned above, are not always easy to establish.

The Chemical Division deals mainly in technological problems, in which direction the industry has made important advances in recent years. A new type of smoke house for crêpe rubber designed by the Institute has become popular and has been built on a number of estates. Other problems are connected with the shipment of latex, for rubber is now being transported in this form in increasing quantities in recent years. For this purpose the latex has to be concentrated. The concentrating of the latex, the preventing of discoloration, and the use of certain reagents for concentrating, are all matters under investigation. Incidentally, it is interesting to note that it has been found that different clones produce rubbers of different consistencies, some, for example, producing rubber of an abnormal softness.

It has only been possible to touch the fringe of the research work that is described in the annual report, but it is obvious that much work is being conducted on sound lines, which augurs well for the future of the industry. Plantation rubber will probably have to face competition from the artificial product in the future, for the effect of the War has been to stimulate research in the manufacture of rubber substitutes by synthetic methods, particularly in those countries which are unable to get natural rubber on account of blockade. It is satisfactory, therefore, to feel that those interested in the plantation industry, which is of such vital importance to Malaya and Ceylon, have taken steps to apply research methods with the object of raising the output per acre and reducing costs, and at the same time have realized the importance of regulating output so that the product may be made available to the whole world, when conditions again become normal, at a reasonable and stabilized price. By such methods the industry will be in the best position to meet any outside competition in the future.

SCIENTIFIC CENTENARIES IN 1941

By Engineer Captain Edgar C. Smith, O.B.E., R.N.

AMONG the men of science whose centenaries occur this year, one stands out above all the others as a great reformer. This is Paracelsus, who died at Salzburg on September 24, 1541, four centuries ago. Born in Switzerland in 1493, he was a contemporary of Copernicus and Luther. In Dr. Seelig's "Medicine, an Historical Outline", Paracelsus is spoken of as "a man of extraordinary power, forceful character, untrammelled thought and ingenious medical instinct". His wanderings, his quarrels and his constant warring against dogma made him known throughout the universities of Europe, and interest in his activities has continued down to the present time. In NATURE of January 18, 1894, there was a note to the effect that the library of Dr. Schubert, of Frankfort-on-Main, contained no fewer than 194 editions of the works of Paracelsus, and 548 books dealing partly or chiefly with him. One of the latest lives of Paracelsus is that of Prof. J. M. Stillman, which was reviewed in these columns on August 12, 1922, by Sir Edward Thorpe.

Paracelsus lived at a time when the study of botany was attracting considerable attention. Medicine and botany went hand in hand, and this led to the foundation of botanic gardens. Those at Padua, Montpellier, Leyden and Leipzig were all founded in the sixteenth century, and that in Paris, now the Jardin des Plantes, in the early part of the seventeenth century. The inauguration of this garden was due to the French physician Gui de la Brosse, who died in 1641. He was a physician to Louis XIII. He bought a piece of land on which refuse had collected and there established in 1626 a Jardin Royal des Plantes Médicinales, of which he became the first superintendent. He collected plants from many parts of the world; in 1636 he made a catalogue of 2,000 specimens, and had upwards of 400 plates engraved. At his death these were disposed of to a brazier, but Fagon, the nephew of Brosse, was able to save about fifty of them from destruction. Nearly all Brosse's writings were about the garden and its plants.

The year 1641 also saw the death of Jeremiah Horrocks, the young Lancashire clergyman and astronomer, the first individual to witness a transit of the planet Venus.

Astronomy of the following century is represented by François de Plantade, of Montpellier, who died on August 25, 1741. With his countryman Clapies, Plantade observed the total eclipse of the sun of May 12, 1706, the first total eclipse of which the accounts, says Grant, have any pretensions to fullness or precision. That same year Plantade assisted in founding the Academy of Sciences at Montpellier. Born in 1670, he died suddenly at the age of seventy when climbing the Pic du Midi to carry out geodetical measurements.

Other men of science who died in 1741 were Ambrose Godfrey, who for many years assisted Boyle in his experiments; George Martine (1702-41), the St. Andrews physician, who in 1740 published an essay on the "Natural and Experimental History of the various degrees of Heat in Bodies", and the Danish navigator, Vitus Behring. who after serving in the navy of Peter the Great, spent several years exploring Siberia, its coasts and seas, and who perished on Behring Island on December 19, 1741.

The great explorers of the eighteenth century include also Jean François de Galaup, Comte de La Pérouse, who was born on August 22, 1741. After seeing active service in the Navy, he was given command, when forty-four years old, of an expedition to the coasts of the Pacific. In 1788 he sailed from Botany Bay, and no trace of him was found until 1826, when it was discovered that his ships had been wrecked on a coral-reef off Vanikoro, north of the New Hebrides. While La Pérouse was still serving in the French Navy, his fellow countryman Alexis-Marie Rochon (1741-1817), optician and astronomer to the Marine, was visiting many places in the Indian Ocean. With Leroy he was made keeper of a cabinet of nautical instruments at Brest. His attainments gained him a seat in 1795 in the newly founded National Institute, and when he died his place was taken by Fourier. Another well-known French man of science born in 1741 was the geologist Barthélemy Faujas de Saint-Fond (1741-1819). He held a chair in the Museum at Paris, and he was among the first to bring forward conclusive evidence of the igneous origin of basalt. His work "On the Extinct Volcanoes of Vivarais and Velay" was published in 1784. About this time he visited Great Britain and was hospitably entertained by Sir Joseph Banks and others. He attended a dinner of the Royal Society Club, of which he wrote, "Brandy, rum and some other strong liquors closed this philosophical banquet, which terminated at half-past seven, as there was to be a meeting of the Royal Society at eight o'clock. . . . I repaired to the Society along with

Sir Joseph Banks, Mr. Cavendish, Dr. Maskelyne, Mr. Aubert and Sir H. Englefield. We were all pretty much enlivened, but our gaiety was decorous." At Windsor, Faujas was startled to find Miss Caroline Herschel assisting her brother in recording observations.

Three Englishmen of note who were born in 1741 were Dr. William Withering, F.R.S. (1741–1799), physician, botanist and mineralogist, of Birmingham, friend of Watt, Priestley and Boulton; Joseph Huddart, F.R.S. (1741–1816), nautical surveyor and chart maker, who made a fortune out of his rope-making machine patented in 1799, and the Cornish clergyman and astronomer, the Rev. Malachy Hitchins (1741–1809). Though he began life as a miner, Hitchins was enabled through his wife to go to Oxford, and in 1767 Maskelyne found him a post at Greenwich Observatory as a computor. He made calculations for the "Nautical Almanac" from 1768 until his death at St. Hilary Vicarage, Cornwall, in 1809: "The reputation which the Nautical Almanac obtained was largely due to his care. . . ."

The names of men of science who died a century ago include those of the famous Swiss naturalist, Augustus Pyramus De Candolle, of Geneva, whose "two-fold enthusiasm was to increase the knowledge and advance the welfare of the human race", and the French entomologist, Jean Victor Audouin, a son-in-law of Alexandre Brongniart, the successor of Latreille at the Muséum d'histoire naturelle, a collaborator with Milne-Edwards and the first president of the French Entomological Society. Another French naturalist who died in 1841 was Jean François D'Aubuisson de Voisins (1769–1841), the geologist, who was the favourite pupil of Werner at Freiburg, but who abandoned Werner's views after he had visited the volcanic region of Auvergne. The same year saw the death of Felix Savart (1791–1841), the physicist who succeeded to Ampère's chair in the Collège de France; of the famous British surgeon, Sir Astley Paston Cooper, who is buried beneath the chapel of Guy's Hospital and whose statue is in St. Paul's Cathedral; of Dr. George Birkbeck (1776–1841), the pioneer of technical education, whose best-known memorial is Birkbeck College, London, and of the two mathematicians, Olinthus Gilbert Gregory (1774–1841) and George Green (1793–1841). Gregory, who was one of the projectors of the University of London, taught for many years at the Royal Military Academy, Woolwich, and was known both as a writer of text-books and as experimenter, while Green is remembered principally for his "Essay on the Application of Mathematical Analysis to the Theories of Electricity and Magnetism", in which he first applied the term "potential" to these branches of science. Green was largely self-taught; and he did not study at Cambridge until he was forty years of age, five years after his essay was published. He was only forty-seven when he died.

Of the many men of science born in 1841, one of the most eminent was the French physicist Marie-Alfred Cornu, For. Mem. R.S. (1841–1902), for many years professor of physics at the École Polytechnique, and in 1896 president of the Paris Academy of Sciences. After his death in 1902, Silvanus Thompson wrote of him in NATURE as a man who had won universal esteem: "A true follower of the great traditions of France in the pursuit of science and a passionate follower of Arago, Biot, Fresnel and Fizeau, he was in his own person much more than this. He was the ideal of a well-equipped well-balanced intellectual leader in scientific thought."

Science in Italy last century is represented in the records by Antonio Pacinotti (1841–1912), who, as a youth serving in the Garibaldean Wars, pondered over the construction of his ring armature dynamo, for the invention of which he is remembered, while science in Switzerland is represented by the Lausanne anatomist and physiologist, François Alphonse Forel (1841–1912), who made a life-long study of the Lake of Geneva, and whom Chrystal called "the Faraday of Seiches".

Centenaries of astronomers of note, professional or amateur, are numerous, for 1841 saw the birth of Herman Vogel (1841–1907), director of the astrophysical laboratory at Potsdam; of Friedrich Engelmann (1841–88), of Leipzig, who published Bessel's collected works; of Theodor von Oppolzer (1841–86), of Vienna; and of Hugo Gylden (1841–96) of Stockholm, both known especially as eminent teachers. Three British astronomers born in the same year are Andrew Ainslie Common (1841–1903), an engineer who became known for his construction of silver-on-glass mirrors; W. E. Crossley (1841–1905), a carpet manufacturer, who at Halifax installed a telescope having one of Common's mirrors which he afterwards gave to the Lick Observatory; and G. F. Chambers (1841–1915), a lawyer, who was the author of an excellent "Handbook of Descriptive Astronomy" which passed through several editions.

To complete this survey, brief mention may be made of several workers in other fields of science. Karl August Lossen (1841–93), a member of the Prussian Geological Survey, was spoken of as the founder of dynamic metamorphism; Edouard François Dupont (1841–1911), another geologist, was the honorary director of the Royal Museum of Natural History at Brussels, and William Topley, F.R.S. (1841–94), who did notable work on the Geological Survey of Great Britain and served as president of the Geologists' Association. Topley began his work on the Survey with Clement le Neve Foster, F.R.S. (1841–1904), who had studied at Freiburg, and in 1890 succeeded Sir Warington Smyth as professor of mining at the Royal School of Mines. In 1903 Foster was knighted. The Irish chemist, Cornelius O'Sullivan (1841–1907), and the English chemist, Walter Flight (1841–85), both owed much to their contact with Hofmann, to whom they became assistants after his return to Berlin. Both were fellows of the Royal Society, but while O'Sullivan's researches were connected with the chemistry of brewing, Flight's investigations led him to the study of the mineralogical constitution of meteorites, his work being done in a laboratory at the British Museum, where he held a post. Of the engineers born in 1841, John Donaldson (1841–99) and George Wallace Melville (1841–1912) were connected with marine engineering. Donaldson was a pupil under Rankine at Glasgow; in 1872 he joined Sir John Thornycroft at Chiswick, and was associated with the development of high-speed torpedo boats and torpedo-boat destroyers. Melville held the high office of engineer-in-chief of the United States Navy for sixteen years, during which period the American fleet grew from an almost negligible force to one of the most powerful.

OBITUARIES

Dr. J. W. Blagden

Dr. J. W. Blagden died on November 28 at his home in Loughton, Essex, in his sixty-seventh year. He came from a scientific family, and was educated at Dulwich and Emmanuel College, and took an honours degree in natural science in 1895. Proceeding to Würzburg, he worked under Häntzsch, obtained his Ph.D., and after a period as senior demonstrator in electro-chemistry at Darmstadt, entered industry with C. F. Böhringer und Söhne as research chemist and departmental manager. He worked on electrolytic oxidations and reductions, and later became interested in the then new field of catalytic hydrogenations. In this, particularly in its applications to industry, he was one of the pioneer workers. The outbreak of war in 1914 put an end to his work in Germany. During the period of hostilities he was an internee at Ruhleben, where as the leader of a group he endeavoured to continue scientific work, an effort typical of a man who refused to be dismayed by difficulties. At the end of the war he returned to England and sought an opportunity to continue his work on catalysts. He joined Messrs. Howards and Sons, Ltd., in 1919 and undertook the organization and direction of a newly formed Research Department. The range of new products manufactured by the firm during the last twenty years is a tribute to the energy and skill with which he pursued the task. In 1929 he was elected a director of the Company.

Blagden was a fellow of the Institute of Chemistry and the Chemical Society, and a member of the Society of Chemical Industry. He served on a number of Committees, among which may be mentioned the Pharmacopœia Commission, the Essential Oils Committee of the Imperial Institute, Chemical Committees of the British Standards Institution and the Patents Committee of the Association of British Chemical Manufacturers.

He had little desire or time for publication, and apart from a few relatively minor papers the record of his work exists in patents and in the technical achievements of the laboratory under his direction.

Dr. Blagden was always accessible to members of his staff, and devoted much of his time to their encouragement and welfare. He felt that industry owed a debt to the universities, and was pleased to acknowledge this by both material and technical assistance whenever possible.

Dr. C. W. Saleeby

Dr. C. W. Saleeby, who died on December 9, aged sixty-six, was a popular lecturer and writer, able to put forward the views he furthered in simple direct language illuminated by apt and telling phrases. He was in particular an exponent of eugenics, in my opinion a lost cause, for the British people cannot be persuaded, and are not stimulated by family allowances by Government, to have enough children to maintain the vigour of the nation after the War. There is great doubt, too, whether eugenics, except in the case of a few rare inherited disabilities, is of any value.

A far more valuable field of Saleeby's propaganda was that of sunlight and open air as givers and restorers of health. He founded the Sunlight League, and its continuance depended mainly upon him. In the *Journal* of this League were well advocated the views he held so strongly. His own dwelling in London was contrived to secure all the benefit possible from sunlight. In his lectures he made much of Rollier's great successes in treatment of tuberculosis at the Leysin Sanatoria and the open air school run there as a prevention of disease for delicate children. In doing so Saleeby did not seem to be aware of the pioneer work of that great surgeon Oscar Bernhard at St. Moritz, who inspired the work of Rollier and whose surgical methods of wound treatment by sun and open air are of great value to-day. With the death of Saleeby an enthusiastic popular teacher has passed away.

Leonard Hill.

NEWS AND VIEWS

President Roosevelt and United Democracy

IN his 'fireside talk' on December 29, President Roosevelt reached the highest point he has yet attained in his career as statesman and a great leader of democracy. No less than the successes of allied arms in the field, it holds out a promise of ultimate victory and marks a substantial stage in progress towards a 'new order' of democratic unity. As he had elected national security rather than war as his topic, his statement was addressed primarily to the people of the United States; but in order that he should place the situation as it affects their country fairly and squarely before them, he was bound by the logic of present realities to show how the forces of aggression embodied in the Axis Powers form a threat to the Americas as a whole, and in aiming at a world domination were bent upon the destruction everywhere of that freedom which is of the essence of democracy. By the cogent argument of the facts of recent history in the action of "a gang of outlaws" against weaker neighbouring peoples, and the inevitable consequences which would follow their success in Europe, he showed that American civilization and American independence "had never before, since Jamestown and Plymouth Rock," been in such danger.

"The Nazis," Mr. Roosevelt went on to point out, "can never reconcile themselves to a democratic world. The Axis proclaims there can be no ultimate peace between their philosophy and ours." The grave warning addressed to the people of Eire indicated that, in the opinion of the President, no less than of others more intimately involved, no reliance is to be placed upon the protection of a neutrality such as that on which Eire takes its stand. To the threat to the Americas the armed forces of Great Britain and those soldiers of its allies who have escaped alone oppose a barrier. Hence it behoves America, in President Roosevelt's words, to become the arsenal of the democracies, and to spare no effort, short of an expeditionary force, to support them. So from the President's exhortation to the American people there emerges a pattern—it might almost seem a prophecy—of a world in which stand united all peoples who hold fast to the democratic ideal, with Great Britain and the United States in the forefront. They stand, and will continue to stand, united in defence of those ideals, freedom, justice and tolerance, everywhere and at all times against aggression and exploitation.

The Fire of London

ON December 29, after four months of vicious, though unsuccessful, attempts to destroy the spirit of London, the Nazis attempted to destroy her heart by fire from the air. Those of us who experienced the wanton assault need no further proof that it was a deliberate attempt to fire one of the most vulnerable points in the world, although no targets of military value were attacked. It may be that the attack was not necessarily one of desperation (as suggested in some quarters), but rather an integral part of the Nazi war effort to destroy anything symbolical of the democratic ideal and tradition. If so, then it has proved a dismal failure; London has withstood its ordeal by fire. It is true that some irreparable material damage has been done. Guildhall is a blackened shell; eight Wren churches have been wrecked; the Central Criminal Court has been damaged; the house in Gough Square, Fleet Street, where Dr. Johnson compiled his dictionary has been burnt out; Goldsmiths' College, which is incorporated in the University of London, was destroyed; and so on. The night was awesome—a clear demonstration of the senseless ferocity of aerial warfare as conceived by the Nazis.

But St. Paul's Cathedral, symbol of the faith of many Britons, stood out as a challenge and an inspiration. It has withstood previous attacks, though that of Sunday, December 29 must inevitably rank high among the many barbarous, though futile, attempts by the German High Command to crush the armies of freedom. History is being writ large; but more important at present is it that here we have further proof, if such is needed, that we are fighting, and must overcome, evil things. Nobody but another Nazi could support such 'strategy', which is eloquent of the very philosophy of totalitarianism, emphasizing as it does, among other things, the total destruction of all that democracy stands for, material and moral. Lovers of freedom, whether in the fighting services, defence services, office, field, library or laboratory, must collaborate wholeheartedly and give of their best, and thus become effective defenders of freedom.

British Museum (Natural History): Air Raid Damage

A NUMBER of bombs, both high explosive and incendiary, have fallen on the Museum premises, and serious fires have occurred in the General Herbarium and the Shell Gallery. Considerable damage was done to the botanical collections, but it will be impossible for some time to arrive at any final conclusion as to the extent of this, since so much depends on the degree of success achieved in the work of salvage and reparation which is still in progress. The greater part of the damage was done by water, and time alone can show how far this is irreparable.

The Shell Gallery was fortunately almost empty when the fire took place, and the damage to the collections was inconsiderable, though the roof of the Gallery was destroyed and a number of show cases were ruined. Some damage has been done by water in other parts of the Museum, but this is believed to be not very great. A vast number of windows and skylights have been broken, and there has been minor damage to the structure and to furniture in various parts of the building. The fossil tree which stood in the Museum grounds has been knocked down and broken but is capable of being repaired and re-erected.

Moss in War-time Medical Dressings

THE position in the War of 1914–18, when the acute shortage of cotton-wool necessitated the widespread use of Sphagnum moss as an absorbent dressing for field wounds, has been anticipated in the present efforts to recommend reserves of this material properly collected and suitably prepared (*Lancet*, Dec. 14, p. 753). During 1914–18, when the War Office officially sanctioned the use of bog-moss and itself ordered considerable supplies from Dublin and Edinburgh War Dressings Supply Centres, Colonel C. W. Cathcart, of the Edinburgh Royal Infirmary, investigated its properties in comparison with other cheap and easily available absorbants and deodorants like pinewood sawdust and peat moss litter and showed its considerable advantage, even over ordinary cotton-wool (*Brit. Med. J.*, July 24, 1915).

The history of Sphagnum as a wound dressing is, however, older than the War of 1914–18. The earliest record is given in Joyce's "History of Ireland", when it was described as used for a wound dressing on the battlefield in the battle of Clonturf in 1014. The first use in medical science was at Kiel, in Germany, last century, when a workman who had lacerated his forearm had it wrapped in peat moss, and he was sent down to Kiel, where he arrived ten days later, and, to the surprise of the medical authorities on removing the moss, the wound had healed most satisfactorily (Neuber : "Erfahrungen über Iodoform under Torf-Verbande", *Arch. klin.-Chir.*, **27**, 757 ; 1882). The first recommendation for its use by the British during the War of 1914-18 was apparently Prof. J. Bailey Balfour's letter to the *Scotsman* of November 17, 1914, although the pioneer work in medical circles was that of Col. Cathcart. The Canadians and Americans in the later stages of the War were preparing considerable supplies of these dressings for their own troops in the field. In 1916 the Irish material prepared at Dublin reached an output of 20,000 dressings a month, 5,000 of which went to the War Office and the rest to eighty hospitals. The Edinburgh station was supplying 2,000 dressings a week for military use without charge.

British Drug Plants

THE wholesale cultivation of drug-producing plants in Great Britain is being encouraged by the Pharmaceutical Society and the Ministry of Agriculture to meet the deficiency of Continental imports, and a medical correspondent in the *Lancet* of December 7 points out the dangerous position arising from the prohibitively high prices and the acute shortage of necessary drugs. A survey by the *Chemist and Druggist* of the present conditions on the nine big commercial drug-plant farms in Great Britain reports a fairly good harvest this past season, but considerable extensions will be required to meet the needs of the manufacturing chemists in 1941. The chief plants required, and suitable for wholesale cultivation as field crops, are deadly nightshade (*Atropa belladonna*), thorn-apple (*Datura stramonium*), henbane (*Hyoscyamus niger*), monkshood (*Aconitum napellus*), foxglove (*Digitalis purpurea*), hemlock (*Conium maculatum*), white horehound (*Marrubium vulgare*), skull-cap (*Scutellaria galericulata*), male fern (*Lastrea Filix-mas*), mother-wort (*Leonurus cardiaca*), chamomile (*Anthemis tinctoria*), wormwood (*Artemisia absinthemum*), squirting cucumber (*Ecballium elaterium*), opium poppy (*Papaver somniferum*), and valerian (*Valeriana officinalis*).

Fortunately, the Ministry of Agriculture's handbook on the subject is an up-to-date work with the experience of the War of 1914–18 ; but, in addition to cultivating the herb crops, accurate methods of early harvesting and early and slow drying are necessary if the full chemical resources of the plants are to be available. It may also be necessary to cultivate herbs of the Labiates, like lavender (*Lavendula vera*), rosemary (*Rosmarinus officinalis*) and wound-wort (*Stachys betonica*), and some Umbellifers, like angelica (*Angelica archangelica*), for their essential oils for the perfumery and essential oil trade. Although the position regarding organic dyes is much better than in the War of 1914–18, the return to cultivation of woad (*Isatis tinctoria*) and other dye-producing plants is envisaged.

Palæolithic Paintings in the Dordogne

IN the enthusiasm of fresh discovery, archæologists at times are apt to overstress the importance of their finds. No reservation is necessary in appreciating the outstanding character of the remarkable discovery of the cave and paintings of palæolithic age at Lescaux in the Dordogne valley, recorded by the Abbé Breuil in another column of this issue of NATURE (see p. 11). Although at the time of writing examination of the cave had proceeded no further than would warrant a preliminary report, sufficient of its nature had already been revealed to justify the conclusion in the opinion of the Abbé Breuil that the discovery is of exceptional importance. To quote his own words "as . . . Déchelette called Altamira 'the Sixtine Chapel of Magdalenian art', so Lescaux represents with equal splendour that of the far more ancient Perigordian". In this remarkable cave with its high central hall and galleries, the latter for the most part still unexplored, are more than eighty paintings, chiefly on blocks fallen from the roof, as well as engravings—in the hall superposed upon the paintings, in the galleries unaccompanied—which it has not yet been possible to examine adequately on account of their delicacy.

In the paintings, the Abbé Breuil distinguishes according to character and technique nine divisions or classes, each depicting characteristically animals or parts of animals, as well as rectangles, comb-shaped signs and other conventional forms. Reindeer and mammoth notably are absent, while "more unusual" is a composition in which black rhinoceros, bison, and a recumbent human form appear—possibly "a prehistoric drama", and if so a valuable piece of evidence bearing upon the nature of palæolithic belief and ritual. From this evidence the Abbé Breuil draws certain tentative conclusions as regards the age of the engravings and paintings. The stags and oxen show a truly remarkable and unique

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similarity with those of the eastern Spanish palæolithic art, where also is found a twisted perspective in depicting horns of stags and oxen, which appears at Lescaux. From this and other comparisons, the important inference is drawn that the paintings of Lescaux are earlier than both Magdalenian and Solutrean, but later than typical Aurignacian. They represent the phase of Upper Palæolithic culture, but recently differentiated and known as "Perigordian".

Prof. Ernest O. Lawrence: Duddell Medallist

THE formal presentation of the seventeenth Duddell Medal of the Physical Society to Prof. E. O. Lawrence, the award of which was announced in NATURE of June 1, p. 852, was made at a dinner of the American Physical Society in Philadelphia on December 27 by Mr. Neville Butler, First Counsellor to the British Embassy and H.M. Chargé d'Affaires *ad interim* in Washington—it had been the late Lord Lothian's intention to present the medal. At a luncheon held by the Physical Society in London on the same day, an interesting word picture of Prof. Lawrence was given by his friend and former pupil, Dr. W. B. Mann. Dr. Mann first referred briefly to the development of the Berkeley cyclotrons, from the 4-inch instrument in 1930 (when Lawrence, at the age of twenty-nine, had recently been appointed professor of physics in the University of California), to the 37-inch (85-ton) and 60-inch (220-ton) cyclotrons and the projected giant cyclotron of some 4,900 tons. He then described the team work of the Radiation laboratory at Berkeley and recalled many incidents to show the outstanding qualities of its distinguished chief—his deep, innate *sense* of physics, his skill in finding the causes of breakdowns, his large share in making the subsequent readjustments until perfect running was again effected, his boisterous and irrepressible enthusiasm away from work (such as on a ski-trip or in his motor-cruiser on San Francisco Bay), and his complete selflessness. Prof. Birge had quoted Lawrence's first remark on being informed of the award to him of the Nobel Prize for Physics in 1939: "It goes without saying that it is the laboratory that is honoured, and I share the honours with my co-workers past and present." Again, the closing words of Lawrence's response at the presentation of that Prize were: "May I again give expression to a profound feeling of gratitude and appreciation for this great honour, which I share with the university and with all those outside who have contributed to make our work possible and, above all, with my valued colleagues and co-workers both past and present." An article based upon Dr. Mann's address appears in the January issue of the *Proceedings of the Physical Society.*

PROF. E. O. LAWRENCE.

New Cyclotron at Berkeley, California

GOOD progress is being made, according to news received recently from the United States, in the erection of the 184-inch cyclotron at Berkeley, California. The cost of this apparatus, it will be recalled (NATURE, May 18, 1940, p. 776), will be more than £200,000, and is being provided by the Rockefeller Institute. The concrete bed for the steel magnet, containing 1,200 tons of concrete, is finished. The erection of the steelwork is now starting, and is expected to be completed by April next. This will contain 3,700 tons of steel, the overall dimensions being, length 56 feet, width 184 inches, height 30 feet. The upper and lower yokes are to be built of some 36 sheets each of steel, 2 inches thick and 56 feet long, bolted and ultimately to be welded together to withstand earthquake shock. 300 tons of copper in the form of strip, 4 inches wide and ½ inch thick, will be required for the windings. The cyclotron is expected to yield one hundred million electron-volt deuterons in a field of 10 kilogauss, for which the resonance wave-length is 39 metres.

Physiology at Cambridge: Mr. W. Freeman

AT a meeting of the Physiological Society held in Cambridge on December 18, a presentation was made by physiologists trained in the Cambridge school to Mr. William Freeman, the senior laboratory assistant. Mr. Freeman, known to many generations of students as 'John', completed his fiftieth year in the laboratory last October. As biological technician he was closely associated with Langley and Anderson in their work on the autonomic system, but during the past fifty years he has aided no less than four of the secretaries of the Royal Society (Michael Foster, Sir William Hardy, Sir Henry Dale and Prof. A. V. Hill) and three of its presidents (Sir Charles Sherrington, Sir Frederick Gowland Hopkins and Sir Henry Dale). The presentation was made by Sir Henry Dale after congratulatory speeches by Prof. E. D. Adrian and Dr. L. E. Shore.

Tercentenary of Jeremiah Horrocks

ON January 3 occurred the tercentenary of the death of the young Lancashire curate Jeremiah Horrocks, whom Herschel spoke of as the pride and boast of British astronomy. In the fourteenth year of the reign of Charles I, and some twenty years before the foundation of the Royal Society, in the hamlet of Toxteth Park near Liverpool and in the village of Hoole, eight miles south of Preston, Horrocks, with the aid of the tables of Lansberg and the works of Kepler, recalculated the transit of Venus and, on Sunday afternoon, November 24, 1639, in between his church services at Hoole, had the great satisfaction of watching the passage of the planet across the sun's disk. His friend, William Crabtree, also observed the transit from near Manchester, but Horrocks's brother Jonas, at Liverpool, failed to see it owing to clouds. Within fourteen months of his achievement, Horrocks had passed away, being then but twenty-two or twenty-four years of age. He had, however completed his "Venus in Sole Visa".

Though he made his observations at Hoole, Horrocks passed most of his life at Toxteth Park, save for the three years 1632–35, which he spent as an undergraduate at Emmanuel College, Cambridge. The site of the house he was born in is now covered by the Otterspool Railway Station; his grave is in the grounds of the ancient chapel of Toxteth, a place of worship associated with the early Dissenters. Not far away is the Church of St. Michael's, and here in 1826, the Lancashire gardener-weaver-astronomer Moses Holden (1777–1864) erected the first memorial to Horrocks. In 1859 the Rev. A. B. Whatton published a translation of his "Venus in Sole Visa", together with a memoir of Horrocks; a memorial chapel and window were added in the same year to Hoole church, and when attention was again being directed to Horrocks's work by the transit of Venus of 1874, steps were taken to place a memorial in Westminster Abbey.

On November 12, 1874, NATURE recorded the permission given for the erection of this memorial, and a list of subscribers, headed by the names of Adams and Airy and including those of Christie, De la Rue, Lassell, Lockyer, Proctor, and "the Village of Hoole". The memorial in the Abbey, unveiled in 1879, consists of a scroll placed within the monument to John Conduitt, the nephew of Newton, at the west end of the nave. Owing to Horrocks's premature death, and the confusion of the times, some of Horrocks's manuscripts were lost. That of the "Venus in Sole Visa" was saved, and a copy passed to Huygens and then to Hevelius, who published it in 1662. Other manuscripts were published by John Wallis in 1673, and these showed that Horrocks had views on many subjects far in advance of his time. In Manchester Town Hall there is a fresco by Madox Brown recalling the observation of the transit of 1639, but in this the scene is Manchester and the central figure is Crabtree.

Psychology of Joan of Arc

IN a paper entitled "A Medico-psychological Revision of the Story of Jehanne La Pucelle" read before the Section of the History of Medicine of the Royal Society of Medicine on December 4, Dr. H. P. Bayon said that modern historians, by interpreting medieval religious conceptions according to the dictates of contemporary critical doctrines, have failed to examine the voices and visions of La Pucelle in their proper light and sequence. The first voices heard at the age of thirteen were, according to him, connected with endocrine activity tinged by intense religious fervour and could not be rightly diagnosed as morbid, even if they ranked as somewhat abnormal. A couple of years after, the simple monitions of the voices were followed by visions and commands, directing the Maid to perform valiant military deeds for a patriotic service; these must be classified as something additional, since their purpose was creative and constructive and furthered the accomplishment of a certain preconceived plan by providing confidence in her mission and obtaining authority for her message. Joan of Arc thus became instinctively the first protagonist of that form of national patriotism which was to play such a part in arranging States and dynasties in Europe during succeeding centuries.

Her courage and perseverance could be matched by other heroines in history; the boldness of her patriotic conceptions was unique, not only for her age and sex, but also because of her youth and lack of military education. In constructive leadership she far surpassed Christine de Pisan, who had full opportunities for obtaining the knowledge requisite in formulating the teachings of French nationalism. Even if her voices and visions were diagnosed as hallucinations, there was no reason to consider these as part of a system of morbid delusions. Not only their form and content but also her subsequent behaviour provided full evidence that she conceived, planned, and put into execution a programme of national survival which obtained historical significance. Such achievements could not be the outcome of the wild vapourings of insanity; they must be the work of creative genius.

Chemistry at St. Andrews

SIR JAMES IRVINE, principal and formerly professor of chemistry of the University of St. Andrews, reviewed the history of chemical teaching at the University in an address on December 6 before the University of St. Andrews Chemical Society. The story goes back, Sir James said, to 1808, when the University accepted a gift of £1,500 from Dr. John Gray, of Paddington, to institute and maintain a chair of chemistry at St. Andrews. This sum was totally inadequate to found the chair, and no appointment was actually made until 1840. While Sir David Brewster was principal of the University, the endowment was brought up to £2,700, and Dr. Arthur Connell was appointed the first professor of chemistry. Connell, who became an authority on mineral analysis, was succeeded in 1862 by Prof. Matthew Forster Heddle. Heddle devoted his attention chiefly to mineralogy; among his students were James Stuart, afterwards the first professor of engineering at Cambridge, Francis Robert Japp, who became professor of chemistry at Aberdeen, William J. Matheson, an American who founded an entrance scholarship and a bursary for chemistry at St. Andrews, and Thomas Purdie, who was to succeed Heddle in the professorship.

Purdie's occupancy of the chair marked a turning point in the history of chemistry and in the history of the University of St. Andrews. In his inaugural address, he stressed the "high educational value" of research; he introduced the study of organic chemistry, and he succeeded in establishing a research laboratory, the first of its kind in Scotland. An uncle of Purdie's left him a large sum of money, which he used to build a laboratory, and he had the satisfaction of seeing his research school well established. Purdie was succeeded in 1909 by Sir James Irvine himself, who continued in the chair until 1920, when he became principal of the University. The next occupant was Sir Robert Robinson, who was followed in 1922 by Prof. John Read. Summing up, Sir James pointed out that the St. Andrews chair of chemistry had had six occupants, five of whom, including the present holder, were fellows of the Royal Society; it had trained sixteen professors and one Government chemist. Altogether, this is a notable record for a chair which has been functioning for just a hundred years.

Health Conditions in Guatemala

IN a recent message to the National Legislative Assembly, General Jorge Ubico, the president of Guatemala, gives the following details concerning health conditions in that country during 1939. 324,031 treatments were given to 67,371 malaria patients, 85,407 persons were treated for intestinal parasites, 2,486 dysentery cases received 13,123 treatments, 4,073 onchocerciasis patients were treated, 64,640 treatments for venereal disease were administered and 250 women were given 7,725 examinations. There were mild epidemics of whooping cough, diphtheria, measles and typhoid fever. The country has seventeen departmental hospitals, which cared for 48,815 persons.

Recent Earthquakes

ON December 20, at about 2.30 a.m. local time, an earthquake shook a wide area in the north-eastern United States and south-eastern Canada. It is reported to have been felt by people for some forty-five seconds in parts of Massachusetts, Maine, Connecticut and Rhode Island, and for a shorter time and less severe in Long Island, New York and New Jersey. In Montreal thousands of residents were awakened by the rattling of loose objects such as crockery on shelves, but no damage or casualties are reported. Another shock affected the same area on the morning of December 24, but only minor damage was caused and no casualties are reported. It is anticipated that the United States Coast and Geodetic Survey and other seismologists in the United States and Canada will be examining both instrumental and macroseismic evidence of the shocks, and any report is awaited with interest.

Also on December 20 an earth tremor was reported to have been felt for several seconds in the lower valley of the Arno River near Florence in Italy. Two earthquake shocks rocked the Erzinjan district of Turkey in the early hours of December 25, according to a message from Ankara. No damage or casualties are reported. The great Turkish earthquake in the same district occurred at 1.57 a.m. local time on December 27, 1939 (NATURE, January 6, 1940).

Comet Cunningham

A SHORT notice about this comet was published in NATURE of November 2 (p. 587). More recent observations have enabled Mr. Cunningham to compute a better orbit, the elements of which are given below:

T	.. ..	1941 Jan 16.25204	
ω	.. ..	199° 35·5′	1940·0
Ω	.. ..	295 42·2	
i	.. ..	49 51·8	
q	.. ..	0·36822	

An ephemeris is given, commencing January 2. The comet is moving rapidly southwards, and after January 10 it will be too close to the sun to be observable. On January 6 it will be near ι Aquilæ and should be easily visible to the naked eye.

	R.A.	Dec.	ϱ	r
Jan. 2	19h. 35·3m.	+5° 54′	0·67	0·54
,, 6	,, 34·3	−2 19	0·62	0·47
,, 10	,, 31·5	12 58	0·59	0·41

Announcements

M. HENRI BERGSON, the celebrated philosopher, has refused to be exempted from the clauses of the new statute relating to Jews in France. The exemption was offered him for "exceptional services rendered to literature, science and art". He will therefore have to resign his chair at the Collège de France.

PROF. ROBERT D. DEFRIES has been appointed director of the School of Hygiene and of the Connaught Laboratories, University of Toronto. During the past twenty-five years he has been prominent in the work of these two institutes, having early in 1915 become actively associated with the late Prof. J. G. Fitz-Gerald, whom he now succeeds.

IN Administrative Memorandum No. 255 the Board of Education refers to the considerable risk of fire due to breaking of bottles containing dangerous chemicals in the event of a school being bombed. Those responsible should take precautions to minimize the risk. Only the smallest quantities of those chemicals, in particular, sodium, potassium, phosphorus, ether and strong acids, should be kept in the building and they should be stored in metal containers.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Stationary Electric and Magnetic Fields in Beams of Light

ACCORDING to the electromagnetic theory of light (Maxwell, Hertz) the electric light vector and the magnetic light vector oscillate perpendicularly to the direction of propagation. The energy of the wave is given by Poynting's vector.

It is shown below, on the basis of experimental findings, that every wave of light possesses likewise a stationary field intensity E in its direction of propagation and also the stationary magnetic field of intensity H. That means there is a potential difference between two points on the ray of light. Accordingly, it should be possible to collect electricity from the ray under suitable conditions. A beam of light therefore constitutes a source of electricity; furthermore, light has magnetizing effects.

Experimental proof of this generalization was obtained from my investigations of the interaction between light and small particles of matter[1]. This permits of the measurement of forces of the order of 10^{-9} to 10^{-10} dynes. The sensitivity of measurements of forces is thus increased by my methods by a factor of 1,000–10,000.

When particles of matter are irradiated by sufficiently intense light of sufficiently small wave-length, regardless of the direction of the wave front normal, then positive or negative electric charges, or north or south magnetic poles, are induced on these particles. Particles of otherwise identical properties move in a homogeneous electric or in a homogeneous magnetic field in or against the direction of the electric field (electro-photophoresis), or in or against the direction of the magnetic field (magneto-photophoresis). These induced temporary electric or magnetic ions exist as long as the particles are irradiated by sufficiently intense light. Furthermore, it can be observed that some particles stay at rest and that their motion commences suddenly, or that moving particles appear to change their velocity and even reverse it. These are due to changes of charge. The movement of magnetic ions in a homogeneous magnetic field is a 'magnetic current'.

These phenomena are best observed when *two* fully symmetrical beams of light are directed against each other and when the fields act perpendicularly, are reversible and free from residual magnetism and electricity, and are also homogeneous. The intensity of this motion depends upon the frequency of the light wave. It increases with increasing frequency and is also dependent on the material. I have also found that, when using just *one* concentrated beam of light, without any field, small particles of matter of magnitude 10^{-4} to 10^{-5} cm. of the same kind as before moved in clean gases either away from the source of light (light-positive, longitudinal photophoresis) or towards the source of light (light-negative, longitudinal photophoresis). This force increases with the intensity of the light and likewise depends upon frequency and material.

There are particles which do not show longitudinal photophoresis at first, but only after a certain time, and some which gradually lose it. I have shown in another paper also that radiometer forces cannot account for these effects[2]. Longitudinal photophoresis has also been found in liquids with particles of the same material. These particles moved in opposite directions (Satiendranat Ray, Lucknow; W. Barkas, London).

Since light makes particles of matter unipolar with respect to homogeneous electric fields, and since, when no such fields act, it makes them move in or against the direction of its wave front normal, there must be an electric field E coincident with the direction of the wave front normal. This means that electromagnetic waves possess longitudinal stationary components of E, and therefore potential differences between different points along the beam. The magnitude of those fields can be calculated from actual measurements.

These facts have been confirmed by further experiments by myself and by some of my pupils. An electric field suitably arranged *parallel* to the wave front normal permits the acceleration or retardation or even reversal of positive or negative photophoresis. The superposed field alters the component of the electromotive force in the direction of the beam.

From similar experiments it can be concluded that stationary magnetic fields exist in the beam of light, since superposed magnetic fields accelerate or retard the magneto-photophoresis. Those stationary magnetic fields in the beam of light have a magnetizing effect on the material as above mentioned.

In conclusion, I find that light beams have electric stationary components in the direction of the wave front normal, and that consequently there must be stationary electric potential differences between different points along the beam. There must also be a stationary magnetic field in the beam of light with potential differences.

FELIX EHRENHAFT.

New York City,
Nov. 28.

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[1] *Ann. Phys.*, **13**, 151 (1940).

[2] *J. Franklin Inst.*, **230**, 381 (1940).

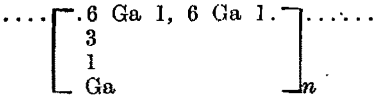
The ε-Galactan of Larch Wood

THE occurrence of this material, which is of considerable interest in connexion with the chemistry of wood formation, has been recognized for some time and it has been shown to contain *d*-galactose and *l*-arabinose residues[1]. In a recent article[2] descriptions are given of esters of this galactan and of its methyl ether, and the authors tentatively conclude that the substance hitherto designated ε-galactan is probably a mixture of a galactan and an araban. As the outcome of experiments carried out before the outbreak of war we had reached a similar conclusion, arrived at from a study of the hydrolysis products obtained from methylated ε-galactan. In view of the fact that Wise *et al.* have not dealt with the hydrolysis of the methyl derivative, we are now summarizing the main features of our results, which, although incomplete, had already given information concerning the structure of this galactan.

The arabinose residues, as shown by their rate of hydrolysis to free arabinose, possess the furanose structure which has been found also in all the naturally occurring arabans hitherto examined[3]. The galactan portion undergoes no appreciable change when subjected to the mild acid conditions which suffice to hydrolyse the araban. This is to be expected since (see below) all the galactose is present in the pyranose form. Furthermore, arabinose-free galactan thus obtained gives a fully methylated derivative $[\alpha]_D - 18°$ in methyl alcohol which is identical with the substance obtained by separation of the methylated galactan from the mixture of methylated galactan and methylated araban produced by methylation of the original ε-galactan. These observations provide strong evidence that the original ε-galactan was a mixture of polysaccharides and that the arabinose residues are not attached to galactose.

On hydrolysis the methylated galactan gave rise to the following products: (1) 2 : 3 : 4 : 6-tetramethyl galactopyranose (1 mol. proportion), (2) 2 : 4-dimethyl galactopyranose (1 mol. proportion), (3) trimethyl galactopyranose (1 mol. proportion). This consisted mainly (perhaps entirely) of 2 : 3 : 4-trimethyl galactopyranose, but with the evidence at present available it is just possible that another trimethyl galactose (2 : 4 : 6 ?) might also be present. (4) A methylated uronic acid is present in very small amount.

These results establish the general type of structure present in the galactan. The three galactose residues which comprise the repeating unit of the galactan molecule are respectively: (1) a terminal galactose residue attached only through C_1; (2) a residue attached to the others through C_1, C_3 and C_6; and (3) a residue attached through C_1 and C_6 (with the possibility, referred to above, that in some residues the junctions may be through C_1 and C_3, depending on whether the presence (in the products of hydrolysis) of 2 : 4 : 6-trimethyl galactose is or is not established). The problem is formally similar to that discussed in papers on the arabans[3]; and as a particular example of the general type to which the structure must conform the following may be cited, in which a chain of β-linked galactose residues has another residue attached laterally as a side chain (Ga = galactopyranose residue):



$$\ldots\left[\begin{array}{l}.6\ \mathrm{Ga}\ 1,\ 6\ \mathrm{Ga}\ 1.\\ \ 3\\ \ 1\\ \ \mathrm{Ga}\end{array}\right]_n\ldots$$

There are obvious variations of this, between which no decision can yet be made. It is not possible to give a definite estimate of the chain-length of the molecule, although it may be mentioned that from viscosity data a molecular weight of about 2,300 has been suggested[4], and the significance of the uronic acid residue present in small amount is not yet apparent. This type of structure is similar to that present in plant gums and reveals a striking general resemblance between this galactan and the araban of pectic materials, although the ring structures of the constituent sugars differ completely and there is no possibility that such an araban could arise by oxidation and decarboxylation of this galactan.

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Nov. 29.

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[1] Wise and Peterson, *Ind. Eng. Chem.*, **22**, 362 (1930).

[2] Peterson, Barry, Unkauf, and Wise, *J. Amer. Chem. Soc.*, **62**, 2361 (1940).

[3] Hirst and Jones, *J. Chem. Soc.*, 502 (1938); 453, 1865 (1939).

[4] Owens, *J. Amer. Chem. Soc.*, **62**, 930 (1940).

Sesame Cake and Antler Growth

ON July 8, 1939, an article by a special correspondent of *The Times* directed attention to the beneficial influence of sesame cake on the growth of antlers. In trials at the London Zoo the antlers of a reindeer, a wapiti and a red deer no less than ten years old considerably improved after they had received the cake. These results confirmed the wider experience of Mr. Franz Vogt, who had previously reported that antler growth among the red deer on his Czechoslovakian estate had increased fifty per cent after adding the cake to their ration[1].

The cause of the stimulation of antler growth is uncertain. The question was brought to our notice by Prof. Julian Huxley. After discussion with him a few experiments were planned to throw light on the problem.

There appeared to be two possible explanations. Either Mr. Vogt was correct in thinking that the sesame cake improved the nutritive balance of the diet of the animals, in particular making good a common deficiency of calcium, or the cake contained an androgenic or gonadotrophic substance effective on oral administration. The latter explanation seemed unlikely, in view of the fact that sesame oil has been widely used as a convenient solvent for administering sex hormones by subcutaneous injection; but it was thought to be worth while making a few experiments which should be decisive.

Accordingly, samples of sesame products were assayed for androgenic and gonadotrophic activity.

The androgenic assays were made with capons. The grain and mash ration was gradually replaced by crushed sesame cake and meal until after ten days they were each receiving 60 gm. of the products daily, supplemented by one feed a week of their normal diet. Measurements made at intervals during the two months period of treatment gave no evidence of comb-growth.

Sesame cake or seed was ground and mixed in equal parts with a normal rat diet, and each mixture fed to groups of immature female rats, for periods of 12 and 42 days. This resulted in an intake of each product of 2–3 gm. per day, and the growth of the animals was quite normal. Ovaries, adrenals, uteri and hypophyses were then dissected out and weighed, but in no case was there any indication of an increase in the weights of these organs. Histological studies of these and the thyroid glands showed no abnormalities.

These negative responses seem to dispose of the possibility of direct or indirect hormonal control of antler growth by any component of sesame products.

We are thrown back, therefore, on the alternative view, for which Vogt has already provided substantial evidence, that it is the high calcium content of the cake, and possibly other nutritive components, which facilitates rapid and increased development of the antlers.

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Dec. 10.

[1] Vogt, F., "Neue Wege der Hege" (J. Neumann, Neudam, 1936).

Effect of Skin Coatings on Apples

IN recent years considerable attention has been given by Hitz and Hant[1], Kaess[2], Smock[3], Platenius[4] and others to the use of skin coatings for the preservation of fruits and vegetables.

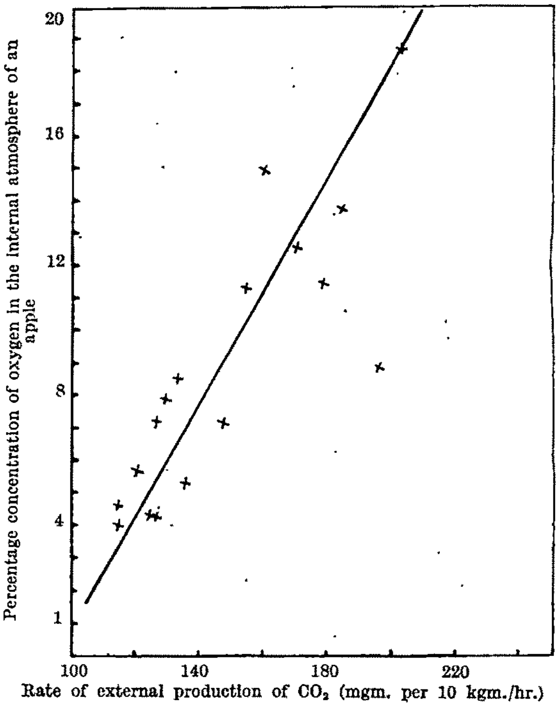
Experiments in this laboratory on Granny Smith apples have been carried out by investigators of the Division of Food Preservation of the Commonwealth Council for Scientific and Industrial Research in co-operation with the Department of Agriculture of New South Wales and the Botany School of the University of Sydney. The fruit was coated by dipping it in solutions of emulsions containing various proportions of oil, wax and shellac prepared so that the total solids were of the order of 5–10 per cent.

The relationship between treatments, internal oxygen and carbon dioxide concentrations, and external respiration has been investigated over a range of temperatures. The method used in analysing the internal gas composition was similar to that of Wardlaw, Leonard and Barnell[5] for papaws and bananas.

Smock and Platenius have shown that there is a marked lowering of oxygen consumption in fruits and vegetables treated with wax emulsions. Numerous workers have shown also that decreasing the external oxygen concentration (within certain limits) decreases the carbon dioxide output of pre-climacteric apples. Our results for pre-climacteric apples indicate that treatment with skin coatings reduces the internal oxygen concentration and thus the external output of carbon dioxide, but does not appear to increase the internal carbon dioxide concentration. The correlation between the internal oxygen concentration and the external output of carbon dioxide is shown in the accompanying figure.

As the storage period is prolonged, it seems that there is a gradual fall in the internal oxygen concentration of untreated fruits due to decreased permeability accompanying ripening changes, and eventually anaerobic respiration may occur. Though treatment with a skin coating may delay the onset of ripening changes, it will accelerate the fall in oxygen concentration when ripening does begin.

Prior to the onset of anaerobic respiration internal disorders may develop in fruit in which the internal oxygen concentration has been reduced to a low value by treatment with a skin coating. In this connexion it is interesting to record that lesions identical with 'brown-heart' developed in Granny Smith apples in which the internal oxygen concentrations were reduced to approximately three per cent by a skin coating but in which the internal carbon dioxide concentration was not significantly increased. Previously 'brown-heart' has generally been associated with fruit stored in atmospheres containing considerably more carbon dioxide than is present in air.



Alcoholic fermentation and internal disorders do not always develop after treatment, and in some cases skin coatings prolong the storage life. The conditions of picking maturity and storage under which a treatment may be beneficial for any particular variety of apple therefore require careful investigation. Other experiments with the Sturmer Pippin, Jonathan, Stayman Winesap, and Rome Beauty varieties indicate that different varieties respond very differently to the same treatments.

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R. N. ROBERTSON.
E. G. HALL.
FRANCES HACKNEY.
Food Preservation Research Laboratory,
Private Bag,
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Sydney. Nov. 7.

[1] Hitz, C. W., and Hant, I. C., *Proc. Amer. Soc. Hort. Sci.*, **36**, 440 (1938).

[2] Kaess, G., *Z. Ges. Kalteindustr.*, **45**, 227 (1938).

[3] Smock, R. M., *Proc. Amer. Soc. Hort. Sci.*, **33**, 284 (1935).

[4] Platenius, H., Bull. 723, Cornell Agr. Exp. Sta. (1939).

[5] Wardlaw, C. W., Leonard, E. R., and Barnell, H. R., Mem. No. 13, Imperial College of Tropical Agriculture, Trinidad (1939).

Detection of Clay Minerals in Soil Mortars by Photo-electric Cell

A RECENT communication by V. L. Bosazza[1] lends point to a description of the application of the photo-electric cell to the determination of the nature of the clay minerals present in soil mortars. After treatment with a solution of malachite green for a period of 10–15 min. to permit of base exchange, the liquid is filtered into a glass cell. The degree of decolorization of the filtrate is a measure of the amount of base exchange between clay minerals and stain, and this can be evaluated quantitatively by placing the filtrate between a light source and a photo-electric cell having a sensitive galvanometer in circuit. Clay fractions which are dominantly quartzose in type remove little of the stain, while those of the kaolinite or beidellite types produce an almost clear filtrate. Colour differences in the filtrates obtained from different clay fractions can then be measured by means of the galvanometer.

The importance of the mineral content of soil mortars has already been demonstrated[2], and the method outlined above offers a rapid means of detection of soil mortars rich in either kaolinite or beidellite clays. It is then only necessary to measure the relation between the volume of the soil mortar and its water content in order to distinguish between soil mortars with dominant kaolinite and those in which beidellite clays are the more abundant. In the former case the expansion is far less than in the latter on increase in moisture content.

It is very unusual to find any reference to the exact nature of the clay fraction present in gravels used for highway foundations when reference is made to the large American and other literature on this subject. Unless this fact is taken into account, serious foundation failures are likely to occur owing to the presence of dangerous clays having marked expansive properties, and it is clear from recent work in the Union of South Africa that the physical properties of the minerals forming the clay fraction are of dominant significance in determining the behaviour of such gravels under field conditions.

B. H. KNIGHT.

Civil Engineering Department,
University of the Witwatersrand,
Johannesburg. Nov. 11.

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[1] Bosazza, V. L., NATURE, 146, 334 (1940).

[2] Knight, B. H., *J. S. African Soc. Civ. Eng.* (July 1940).

Reservation of Scientific Workers

THE classification of scientific workers in the Schedule of Reserved Occupations results in an extremely inefficient use of scientific talent for the national cause, and is giving rise to much bewilderment and exasperation.

The list includes a few highly special classes, and a few very broad ones, with a variety of ages of reservation. The difficulty is that many classes overlap, and that most scientific workers can with equal propriety be included in several of them. An early example arose from the separate classification of university teachers and research workers in universities. Most science lecturers do some research, and many of them devote nearly all or even all their time to research. Chemists, physicists, histologists (not human), exist side by side with the class which can cover them all, namely, that of "research worker in a recognised institution". In practice, this last class includes those whose specialities are not separately listed, and those who fall midway between other listed categories. A physical chemist, being neither quite a chemist nor quite a physicist, would register in the general class, with the result that he is now reserved at thirty, instead of at twenty-one, as he would have been had he called himself a physicist.

The situation, which is certainly most worthy of contemplation, is that of a scientific worker being called up while his own laboratory assistant is left. This has already happened, and must soon be happening on a large scale, for the laboratory assistant is reserved at twenty-five in his trade capacity and at twenty-one for general service, which has meant, in practice, that he is reserved at the lower age. Yet it usually takes the man of science as many weeks to train his assistant as he himself took years to be trained.

A most remarkable complete omission from the list is that of mathematician; if he applies his mathematics to physics he may be reserved as a physicist, but if his mathematics are sufficiently 'pure' to be applicable to all sciences, then he is not reserved at all. A biologist, who has specialized in genetics, may be of the greatest use to agricultural research, but he will be called up under thirty, because there are too few geneticists to make a separate category.

These anomalies have given rise to the curious practice of changing the description of the occupation on the Ministry of Labour Index, as ages of reservation alter. A more rational procedure, and one which would give less work to the departments concerned, would be to make individual reservations on the basis of information filed at the Central Register. Since this information was recorded before the issue of the Schedule it would be unbiased by any consideration of reservation ages and, moreover, includes proper particulars of capacities to do work outside the present occupation.

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A. C. FABERGÉ.

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Dec. 9.

Early Post-Glacial Conditions in England

DR. L. HAWKES'S[1] interesting letter raises wide issues, if (as we believe should be done) the more precise term 'early Post-Glacial' be substituted for 'Pleistocene'. That a tundra condition in Britain succeeded the disappearance of the Pleistocene ice-sheets now seems more than probable. Evidence for this is widespread. In the great sand-pit at Greenside, north Durham, one of us (W.A.) in 1936 noticed several 'sand-dykes' with funnel-shaped tops, which we agreed were due to frost cracking. Since then many other instances have been noted in north-east England, always in surface deposits, and usually, though not invariably, in gravels; and solufluxion phenomena are known on the Yorkshire coast, while other tundra phenomena abound in the north Lincolnshire gravels.

These data confirm Kilroe's[2] admirable description and figure (made so long ago as 1908) of frost-cracks in some north Irish gravels, and recorded by him as proof of tundra conditions. Each and all are definitely Post-Glacial. They are therefore presumably contemporaneous with Nehring's tundra period of the north German Plain. May it not be that Reid's[3] "thoroughly Arctic fauna and flora", so well known in the south of England, as seen in the Coombe Rock and other deposits, are of similar date?

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[1] NATURE, 146 560 (1940).

[2] *Mem. Geol. Sur. Ire.*, "Geology of Country around Londonderry", 62, 63 (1908).

[3] *Quart. J. Geol. Soc.*, 43, 360 (1887).

RESEARCH ITEMS

Bronze Age Cemetery near Glasgow

IN May 1936, the discovery by a workman of "a strange old pot" at Springhill Farm, Baillieston, near Glasgow, led to the identification of a cemetery site on which excavations were carried out by J. Harrison Maxwell, so far as agricultural operations allowed, in the months following until the next sowing for crops (*Trans. Glasgow Archæol. Soc.*, N.S. 9, 4; 1940). The cemetery contained three cremation burials. The first burial found was indicated by two food vessels, of which one, rather squat, was remarkably beautiful. Here no human remains were definitely detected, but carbonized wood nearby may indicate either a wooden vessel or a cremation burial. The second burial was a cist with two lots of cremated bones. Although no grave goods or pottery were found, it had all the characteristics of a bronze age burial. Two small heaps of ashes were found on top of the north cover stone; nineteen white quartz pebbles were associated with the bones. A remarkable feature of the north cover stone was a cut-out, somewhat oblong in shape, measuring 6⅝ inches by 3½ inches and about half an inch in depth. A shallow groove runs through the middle of the cut-out and across the stone. The cist was of unusual form, being tongue-shaped, measuring 4 ft. in length and 21 in. in greatest breadth at the south end. A blue glass bead was found at a depth of 2 ft. about 20 ft. from the Food Vessel site. Six inhumed burials were found, but in the absence of pottery, etc., cannot be dated. Two square pits containing charcoal and iron slag prove the existence of a bloomery here in the Early Iron Age or later.

Anuran Parasites

SEVENTEEN years ago, Maynard M. Metcalf gave an account of the opalinid ciliate infusorians which, with few exceptions, are found in the anuran amphibians, in which they are widely and generally distributed. The author himself has continued the work in the interval and other workers have also added both to the number of known species, the life-histories and the cytology of the family. This work is now reviewed in considerable detail by the same author (*Proc. U.S. Nat. Mus.*, **87**; 1940). The two publicalications constitute a monograph of the Opalinidæ. In the present paper thirty new species are described and illustrated, as are also the species recorded by other workers in the interval. Perhaps the most interesting section for the general reader is that dealing with the geographical distribution of the parasites and their hosts. It is illustrated by numerous maps, and gives the author an opportunity of speculating on the phylogeny of both the Anura and the Opalinids.

Corpus Luteum in Reptiles

SINCE the endocrine functions of the corpus luteum are so intimately bound up with phenomena essentially associated with mammalian reproduction, it is interesting to find that a similar organ is developed in reptiles. A good account of it in a gecko, *Hoplodactylus maculatus*, has been given by Mary M. Boyd (*Quart. J. Micro. Sci.*, **82**; 1940), who also provides a description of the ovary and various stages of oogenesis. As in other craniates laying megalecithal eggs, a prolonged diplotene stage is passed through. The egg is provided with a striated membrane composed of material similar to that of the zona pellucida. The epithelial wall of the follicle, originally many-layered and exhibiting three different types of cells, is reduced to a single layer. The corpus luteum itself is very similar to that in the marsupials and is composed of luteal cells and fibroblast cells from the theca externa, but the cells of the theca interna do not take part in its formation. While a lipoid secretion is present in the luteal cells, there is as yet no experimental evidence as to its functional significance.

Placentation of Hyrax

A FULL account of the placentation of *Procavia capensis* is given by G. B. Wislocki and O. P. van der Westhuysen (Cont. to Embryology, Publ. Carnegie Instit., **171**; 1940). It is found that a transient yolk-sac and a permanent allantoic vesicle are represented, the latter developing into a large four-chambered sac. The trophoblast proliferates over the entire surface of the blastocyst. A trophoblastic network is formed into which chorionic mesoderm gradually penetrates. The placenta is of the hemochorial type. The memoir is well illustrated, and the authors' conclusions may be quoted. "The placenta and fetal membranes of Procavia, the elephant and the manatee exhibit very close structural affinities. Furthermore, the peculiar configuration of the allantoic sac and its vessels is practically identical in Procavia and in lemurs; otherwise placentation in these two groups is quite dissimilar. The mode of development of the placental labyrinth in Procavia resembles very closely that occurring in Tarsius. The marked similarities between the placentæ of Procavia, Elephas and Trichechus are interpreted as indicating phylogenic affinities, whereas the similarities between Procavia and the lemurs and the tarsoids are regarded as representing independent, parallel lines of development."

Central American Plants

DURING 1938–40 two botanical expeditions to Guatemala were led by P. C. Standley and J. A. Steyermark of the Field Museum, Chicago. All but one of the twenty-two provinces of the country were visited and very extensive collections were made. A preliminary report has been published (Field Mus. Nat. Hist., Bot. Series, 22, No. 4; Sept. 1940) containing descriptions of some of the many new species discovered together with notes on plants new to the country and otherwise notable species. Forty-six new species and four new genera are described. An outstanding discovery was a plant which the authors have named *Rojasianthe superba*. This they describe as "one of the most elegant and beautiful plants we have ever seen" and "one of the handsomest and showiest of the Compositæ ever collected". It has large heads with paper white or lilac tinged ray florets and black disk florets; in habit and appearance it suggests an affinity with Dahlia, but it possesses highly distinctive generic characters. It was discovered in ravines in the mountains of western Guatemala ranging from 7,000ft. to 12,000 ft., and the authors believe that it might flourish in southern England. It is remarkable that a plant of such exceptional beauty and horticultural merit should have escaped detection for so long. Another new genus is Orthion (Violaceæ) from northern Guatemala and British Honduras. Two arborescent species are described, one a tall tree attaining 18 metres with a trunk 45 cm. thick.

The Composition of Human Hair

IT is known that eukeratins, for example, wool and hair, are distinguished from pseudokeratins in that their basic amino-acids (histidine, lysine and arginine) are found in a relatively constant molecular ratio of 1 : 4 : 12. The proportions of non-basic amino-acids show wide variations, particularly with respect to cystine, a high content of which is characteristic of keratins. Previous workers have reported no constant relation between cystine content and colour, age or sex, although there was an apparent tendency for the values to be larger in adult hair. R. C. Clay, K. Cook and J. I. Routh (*J. Amer. Chem. Soc.*, 62, 2709 ; 1940) have made experiments on the cystine, cysteine, nitrogen and sulphur content of 120 samples of human hair. No consistent relation between age and composition was found. There was more cystine and cysteine in male than in female hair. Dark hair contained more cystine than light hair. No significant variations in the nitrogen and sulphur content were observed.

Oxygen Exchange between Water and Anions

THE use of heavy oxygen ^{18}O as a means of investigating the mechanism of certain reactions has been recognized and many investigations in this field have been made, and some general conclusions have been drawn. The rate of reaction is often determined by the *p*H of the solution. The exchange of oxygen between water and the chromate, hydrogen sulphate, sulphite, metabisulphite, thiosulphate and permanganate ions, under conditions of varying temperature and *p*H, has been investigated by G. A. Mills (*J. Amer. Chem. Soc.*, 62, 2833 ; 1940). Exchange with sulphates in acid solution agrees with the reversible formation of anhydride $H_2SO_4 = H_2O + SO_3$. The exchange with chromates proceeds faster than can be accounted for by the reaction $Cr_3O_7'' + H_2O = 2\,HCrO_4'$ and the reaction $CrO_3 + H_3O = H_2CrO_4 = H^{\cdot} + HCrO_4'$ is suggested. No exchange was observed with potassium sulphite. No evidence of direct interchange of oxygen atoms was found. For some anions addition and subsequent removal of H_2O or OH' to the anion is apparently the mechanism, whilst with the bicarbonate ion previous work has shown that the mechanism is hydrolysis to form undissociated acid followed by reversible anhydride formation. The last mechanism is shown to account for the exchange reactions with inorganic oxy-anions.

Heat of Hydration of the Proton

THE heat of hydration of the proton : H^+ (gas) + Aq. = H^+_{aq} may, as is known, be calculated by the Born-Haber cycle applied to a halogen hydracid H*x*. The calculation involves a knowledge of various magnitudes, some of which have recently undergone revision, and also some assumptions. E. C. Baughan (*J. Chem. Soc.*, 1403 ; 1940) has recalculated the value for all four halogen hydracids, arriving at the average value of 282·5 k.cal. (± 3 k.cal.). The heat of hydration of the proton is required in the application of cycles of the Born-Haber type to acids and bases, and this new value appears to be preferable to the one previously calculated from the data for HCl only. It should be remembered, however, that several assumptions have been made in the calculation.

The Surface of Mars

THE close approach of Mars to the earth a year ago provided a favourable opportunity for close observation of the planet's disk from southern latitudes. Dr. E. C. Slipher of the Lowell Observatory, who obtained some 8,000 photographs from South Africa during the summer of 1939, describes his work in the *Telescope* of September–October 1940. The article is illustrated with nearly forty half-tone reproductions of selected plates ; from these excellent copies some idea can be obtained of the fine detail reached by the original photographs. The irregular changes noted during the opposition were striking and are described in some detail ; the seasonal changes followed their expected course and are dealt with briefly. Dr. Slipher claims that his photographs record so many of the 'canals' and 'oases' in the positions and of the forms shown on Lowell's maps of the planet that the reality of these markings must now be regarded as beyond doubt. A recent suggestion that the canals are divisions between areas of unequal shading is discounted ; no example has been discovered where the surface brightness on the two sides of a canal shows any visible difference. The colour-filter photographs suggest that the hazy north polar hood, which showed very rapid day-to-day variations of form during the 1939 opposition, is atmospheric in origin ; it precedes and accompanies the deposition of the more brilliant white polar cap, and may consist of very fine ice spicules.

Variable Extent of the Atmosphere of Zeta Aurigæ

A. BEER (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9 ; June 1940) has discussed material relating to the 1937 eclipse of this star, though the observations were made difficult by the low altitude of the star and by cloudy periods. The chief point in the paper is concerned with the remarkable behaviour of the *K* line of Ca II, and as this is produced in the extensive atmosphere of the *K*5 giant, significant changes in the structure of the atmosphere of this star are indicated. The new spectroscopic material covers about a month before the beginning of the 1937 eclipse (April 21·85) and the spectrophotometric investigation of the material was performed with the recording photomicrometer of the Solar Physics Observatory, Cambridge. Christie and Wilson (*Astrophys. J.*, **81** ; 1935) derived a theoretical expression for *N*, the number of atoms in the line of sight, based on Milne's theory of chromospheric equilibrium, and the failure of the 1934 observations to support the theory led them to remark : "Accordingly we conclude that the observations of the Ca ii envelope surrounding ζ Aurigæ are in disagreement with the predictions of Milne's theory." Fundamental changes in the atmosphere of the star during the 1937 eclipse do not allow this conclusion to be maintained, and, as Beer points out, there is now a much improved agreement with Milne's theory.

It is suggested, therefore, that the Egyptian of the time of Menes was starting his year with an observation of the reappearance of Sothis. The threefold division of the year was borrowed from prehistoric cus[illegible] with some modifications. The three seasons, [illegible] spring and harvest, each consisted of 120 [illegible] The 'moons' were continued as 'months' for [illegible] purpose of 30 days exactly, or three ten-day [illegible] and the year consisting of twelve months [illegible] days "over and above the year", subject [illegible] of one day or more owing to inaccurate [illegible] and the occurrence of an extra day each fourth year. This endured during the first two dynasties, yet it is known that throughout the later historical period the year differed from the star and the Nile. When was this "wandering" year first used ? Between 1317 B.C., when the New Year coincided with the appearance of the star, and 2773 B.C., there are several items of evidence that the civil calendar was consistently 'wandering' and at variance with the true seasons by about one day for each four years which had elapsed since 2773 B.C. The conclusion is inescapable that in that year the calendar had been in agreement with that star, and that in that year the observations on which that relation had depended were discontinued. The date is astronomically fixed as the start of the wandering calendar of succeeding centuries.

It is suggested that the change may have taken place in connexion with the period of prosperity which followed on the accession of Djoser, founder of the Third Dynasty, in 2778 B.C. The host of census takers, tax collectors and royal scribes who were engaged in managing the land under a powerful centralized government no doubt found a year whose beginning depended upon the observation of a star highly inconvenient, and preferred to adopt a year with a definite period of 365 days. Owing to the discrepancy between this year and the heliacal rising of Sothis amounting to one day in each successive period of four years, by a century or so later it became necessary to observe two New Year days, "the Opener of the Year" or "the Coming Forth of Osiris" and "The First of the Year", the latter in all likelihood being the New Year inserted into the calendar when it became definitely and obviously separated from Nature. When the calendar became less and less dependable in foretelling the true season, it was probably the time at which the priests invented the coronation oath which called for the new king to swear "never to intercalate a month or a day, nor to vary a festival, but to preserve the 365 days as they were ordained of old".

On the view here put forward the ancient Egyptian calendar was not an invention on any one day at dawn, when a series of phenomena happened to coincide, but it was a gradually developed method of predicting approximately the almost unpredictable rise of the Nile. For a few centuries before 2773 B.C. it depended upon observation of the reappearance of Sothis, and the resulting self-adjusting year was as true a measure of solar time as was the later Julian year. As man became more cultivated he felt the need of some measure of time-reckoning more definite than Nature itself. In 2773 B.C. he dropped the New Year observations and took up the 365-day year, which actually brought his seasons back into their original places only once again during his whole history.

THE FUEL RESEARCH BOARD

THE report of the Fuel Research Board for the year ending March 31, 1939, has recently appeared*, As this date was passed more than one and a half years ago the contents have lost their freshness. They reveal the measure of activity of national research on fuel problems before the outbreak of war and allow the reader to judge of the use made of the results.

The report opens with the work of the coal survey—one of the most important branches of the Board's activity. To realise this it is only necessary to recall the limited and superficial character of the scientific data about British coals during the War of 1914–18. The information accumulated in the meantime has already been turned to good use. It is also noticeable that the survey officers have passed the mere compilation of analytical data and have been able to reach valuable conclusions about the properties and applications of coal and the geology of the coalfields.

The growing importance of coal preparation is shown by the length of the relevant section, which reaches forty pages. Coal users are no longer content with any fuel, and even the householder is unwilling to receive and break under his own roof large lumps of fuel. Modern housing is not designed to store large stocks of dirty material which necessitates manual preparation before use. Effort is being made to prevent dust by coating lump coal with oils and hygroscopic salt solutions - problems which give rise to interesting physical problems. Although the distribution of fuel in fluid form has obvious advantages, war-time conditions show that there is merit in the possession of household stocks of solid fuel which a dispersed population can enjoy.

Oil synthesis from coal by different routes occupies the largest share of the report. Coal and coal tars—particularly the latter—form a source of liquid fuel. Hydrogenation of tars and oils was applied first to low-temperature tars and continued with gasworks tars, then coke-oven tars. As the work has proceeded the discovery of more active catalysts has enlarged the scope of the process.

The production of lubricants from coal has proved more difficult than the production of fuels, at any rate by hydrogenation. More promise is shown by synthesis from mixtures of carbon monoxide and hydrogen—the so-called Fischer-Tropsch process. By polymerization, certain fractions have been converted to products similar to natural lubricating oils suitable for internal combustion engines. Although these were not equal to the Air Ministry's standard, the hope is expressed that this will be reached.

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* Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1939, with Report of the Director of Fuel Research. Pp. iv+206. (London: H.M. Stationery Office, 1940) 3s. 6d. net.

The use of gas producers for propelling road-vehicles has been studied at the Fuel Research Station since 1923 and in recent years more intensely. The work reported has been concerned mainly with the choice of suitable fuels and done largely in close association with the officers of the Coal Survey. The number of vehicles propelled by producer gas and seen on the roads is relatively small—possibly because the need for petrol substitutes has not been too pressing. There has, however, been no lack of scientific and industrial effort.

The section on domestic heating is largely concerned with the measurement of smoke emission and the means for its abatement. It was found that design of fire-places conducive to securing admixtures of products of combustion with air and to conserving their high temperature would make a considerable reduction in smoke. Unfortunately, present circumstances do not make the advantages of smoke reduction so evident as they will be when peace returns.

H. J. HODSMAN.

FORTHCOMING EVENTS

Wednesday, January 8

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1.) at 2.30 p.m. Prof. S. Zuckerman: "The Problem of Blast Injuries."

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

PRINCIPAL OF LISBURN TECHNICAL SCHOOL AND ORGANIZER OF TECHNICAL EDUCATION—The Secretary, Lisburn and Belfast (Rural) Regional Education Committee, Castle Chambers, Lisburn, Co. Antrim (January 15).

LECTURER IN MECHANICAL ENGINEERING—The Principal, Walsall Technical College, Bradford Place, Walsall (January 18).

ASSISTANT EXECUTIVE ENGINEERS in the Punjab Service of Engineers, Class I—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (quoting Appointment 1/11/A) (January 24).

PROFESSOR OF ANATOMY—The Secretary and Registrar, University, Bristol (January 30).

TEACHER OF ELECTRICAL ENGINEERING in the Smethwick Municipal College—The Chief Education Officer, 215 High Street, Smethwick.

SENIOR LECTURER IN MECHANICAL ENGINEERING—The Clerk to the Governors, South-West Essex Technical College and School of Art, Forest Road, Walthamstow, London, E.17.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Mammals and Man: Handbook to a Temporary Exhibition, November 1940 to April 1941. By Colin Matheson. Pp. 22. (Cardiff: National Museum of Wales and Press Board of the University of Wales.) 3*d*. [212

Proceedings of the Royal Society of Edinburgh, Session 1939–1940. Vol. 60, Part 3, No. 26: Some Confluent Hypergeometric Functions of Two Variables. By A. Erdélyi. Pp. 344–361. 1*s*. 6*d*. Vol. 60, Part 4, No. 27: The Design and Interpretation of Experiments based on a Four-fold Table; the Statistical Assessment of the Effect of Treatment. By Dr. W. O. Kermack and Dr. A. G. M'Kendrick. Pp. 362–375. 1*s*. 3*d*. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [212

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 12, No. 1, June 1940. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies and Catherine Robson. Pp. iv+74. (London: H.M. Stationery Office.) 4*s*. 6*d*. net. [512

Hannah Dairy Research Institute. Annual Report for the Year ending 31st March 1940. Pp. 20+4 plates. (Kirkhill: Hannah Dairy Research Institute.) [612

Town Planning Institute. Town and Country Planning: Compensation and Betterment. Report of Committee of the Institute approved by the Council of the Institute, 31st May 1940. Pp. 60. (London: Town Planning Institute.) [612

Memoirs of the Cotton Research Station, Trinidad. Series B, Physiology. No. 13: The Effect of Ringing on the Upward Movement of Solutes from the Root; The Effect of Ringing and of Transpiration on Mineral Uptake. By E. Phillis and T. G. Mason. Pp. 16. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*. [1012

University of London: Institute of Archaeology. Geochronological Table No. 2: The Age of Neanderthal Man, with Notes on the Cotte de St. Brelade, Jersey, C.I. By Frederick E. Zeuner. (Occasional Paper 3.) Pp. 20. (London: Institute of Archaeology.) 3*s*. [10

The Control and Extermination of Wild Rabbits. By A. D. M[illegible]ton. Pp. [illegible] (Oxford: Bureau of Animal Population.)

Herbage Publication Series. Bulletin 30: The Gras[illegible] Argentine and Patagonia. By William Davies. P[illegible] (Aberystwyth: Imperial Bureau of Pastures [illegible] Crops.) 2*s*. 9*d*. [1212

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Thirty-third Annual Report 1939–40 presented by the Council to the Court of Governors on the 25th October 1940. Pp. 49+2 plates. (Cardiff: National Museum of Wales.) [1312

Other Countries

Southern Rhodesia Geological Survey. Short Report No. 32: Report on the Geology and Mines of the Insiza—Fort Rixon Gold Belt. By R. Tyndale-Biscoe. Pp. 23. (Salisbury: Government Printer.) [212

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 191: Measurement of the Period of Natural Vibration of an Airscrew Blade. By Jûichi Obata and Yahei Yosida. Pp. 97–108. 30 sen. No. 192: Viscosity Characteristics of Lubricating Oils as related to their Chemical Structure. By Bunnosuke Yamaguchi. Pp. 109–136. 50 sen. No. 193: Dynamical Stability of a Column under Periodic Longitudinal Forces. By Ikuo Utida and Katsutada Sezawa. Pp. 137–184. 80 sen. No. 194: On the Subsonic Flow of a Compressible Fluid past an Elliptic Cylinder. By Isao Imai and Takasi Aihara. Pp. 185–212. 45 sen. No. 195: Some Experiments on the Forced Vibration of Varying Period. By Katsutada Sezawa and Wataru Watanabe. Pp. 213–228. 30 sen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) [212

New Zealand: Marine Department. Fisheries Bulletin No. 8: Natural Reproduction of Trout in New Zealand and its Relation to Density of Populations. By Derisley F. Hobbs. Pp. 93. (Wellington: Government Printer.) 3*s*. [312

Bulletin of the American Museum of Natural History. Vol. 77, Art. 5: *Meryochoerinae*, a New Subfamily of Oreodonts. By C. Bertrand Schultz and Charles H. Falkenbach. Pp. 213–306. (New York: American Museum of Natural History.) [312

U.S. Office of Education: Federal Security Agency. Bulletin, 1940, No. 2: Statistics of Public High Schools, 1937–38. (Biennial Survey of Education in the United States, Chapter 5.) Statistical Tables prepared under direction of David T. Blose; Text prepared by Carl A. Jessen. Pp. vi+192. (Washington, D.C.: Government Printing Office.) 15 cents. [312

Madras Fisheries Department. Administration Report for the Year 1938–39. By Diwan Bahadur Dr. B. Sundara Raj. Pp. iii+76+2. (Madras: Government Press.) 8 annas. [312

Proceedings of the United States National Museum. No. 30[illegible]: Further Studies on the Opalinid Ciliate Infusorians and their Hosts. By Maynard M. Metcalf. Pp. 465–634. (Washington, D.C.: Government Printing Office.) [412

Anthropological Records. Vol. 2, No. 5: The Social Organization of the Haisla of British Columbia. By Ronald L. Olson. Pp. 165–200. 35 cents; 2*s*. net. Vol. 4, No. 1: Culture Element Distributions, 12: Apache-Pueblo. By E. W. Gifford. Pp. vi+208. 2 dollars; 12*s*. net. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) [612

New Zealand: Department of Lands and Survey. Annual Report on Public Domains and National Parks of New Zealand. Pp. 10. 6*d*. Report on Scenery Preservation for the Year ended 31st March 1940. Pp. 8. 6*d*. (Wellington: Government Printer.) [612

The Dissection of the Shark *Eulamia menisorrah* (Müller and Henle): an Illustrated Guide for the use of First-Year University Students. By G. A. C. Herklots. Pp. 28. (Hong Kong: The University.) 1 dollar; 2*s*. [1012

U.S. Office of Education: Federal Security Agency. Bulletin, 1940, No. 1: Educational Directory, 1940. Pp. iv+48+28+86+72. Know Your School Leaflet No. 55: Know Your State Educational Program. By W. S. Deffenbaugh. Pp. iv+26. 5 cents. (Washington, D.C.: Government Printing Office.) 1012

Commonwealth of Australia. Report of the Director of the Commonwealth Solar Observatory to the Advisory Board. Pp. 8. (Canberra: Commonwealth Government Printer.) [1012

Malayan Forest Records. No. 13: Timber Utilization in Malaya. By H. E. Desch and A. V. Thomas. Pp. ix+31+35 plates. (Kuala Lumpur: Forest Department.) 3 dollars; 7*s*. 6*d*. [1212

Canada: Department of Mines and Resources: Mines and Geology Branch: Geological Survey. Paper 40–13: Preliminary Map, Wapiabi Creek, Alberta. By B. R. MacKay. 10 cents. Memoir 222: Malartic Area, Quebec. By H. C. Cumming and J. W. Ambrose. (No. 2454 Pp. v+142+7 plates+4 maps. 50 cents. (Ottawa: King Printer.) [1

Ministry of Agriculture: Technical and Scientific Service. Bul No. 150: Hot Air Treating Machines used in the Ginneries for Destruction of Pink Boll Worm in the Cotton Seed. By Mohamn Fouad El Gammal. Pp. 20+40 plates. P.T. 5. Bulletin No. 219: Variety-Tests on some Introduced Sugar Cane Varieties. By Gadallah Aboul Ela. Pp. 14. P.T. 2. (Cairo: Government Press.) [1912

AND OCCURRENCE IN GIPPSLAND, VICTORIA

E, in a desire to clarify the ard to the occurrence of oil in ed out a critical examination of e on the subject and has also paid to the Lakes Entrance region in a geologist, a palæontologist and a ngineer. The report of his findings issued this year shows that, in so far as the litera- oncerned, this is in many ways incomplete and, over, embodies a wealth of conflicting opinions. or example, the Oil Advisory Committee's report of February 1937 reflects a cautious but optimistic view of oil possibilities in the Lakes Entrance area, while another report issued by the same authority and only a year later takes a definitely pessimistic outlook of such possibilities. A third report issued by the Committee at the end of 1938 was as constructive as the preceding one had been destructive.

Mr. E. A. Kodyen's report, written in 1939, considered the possibility of repressuring the Lakes Entrance field, but met with little support and definite opposition from Dr. A. Wade. Mr. F. Chapman advanced the view that there is a considerable thickness of "granite wash" below the glauconite or oil horizon, but this was not accepted by the Mines Department, which contends that the glauconite rests on or near bedrock. In spite of the importance of this point, reluctance was shown to permit the Government drilling plant to be used to decide the question. In 1937 Dr. Arthur Tieje visited the field and afterwards urged that a more complete and detailed study of underground structure should be made; but the investigation is still far from complete.

Sir Edmund Teale in his report maintains that incontrovertible data are still insufficient to permit accurate estimates to be made of proved resources. Moreover, investigations are not far enough advanced for any recommendations to be made as to the best method for recovery of the oil and the percentage which should be recovered. Nevertheless, results of carefully recorded tests carried out by the Austral Oil Company indicate that the area, if exploited, might be comparable with other low-pressure production fields in different parts of the world. Admittedly the oil is not petroliferous, but it yields three useful products, all of which have at present to be imported. These are bitumen, heavy oil and lubricating oil. In view of the usefulness of these products *per se*, it would not be necessary to consider the installation of cracking plants for the production of petrol. A disadvantage of the field is that it is definitely a low-pressure area where ordinary pumping methods are of little use. Some form of pressuring would be necessary and before embarking on any such scheme, expert advice would have to be procured.

During his inspection of the field, Sir Edmund visited Holland's Landing, near the western shore of Lake Victoria, where there is a modern plant in operation capable of attempting to penetrate the Tertiary deposits, which there attain a thickness of some 3,600 ft. In addition, sites were visited where scout drilling was in operation and also where boreholes had been completed and cores preserved for inspection. For the most part, however, there was evidence of much haphazard and unprofitable drilling carried out by private enterprise. Reliable records had not been kept until recently, when the Austral Oil Company undertook to make a series of regular tests from selected boreholes over a considerable period of time.

Sir Edmund's general impressions of his visit are summarized at the end of his report. Evidence of proved and potential oil in the Lakes Entrance area, in his opinion, warrants installation of approved methods to attempt recovery on a commercial scale. To this end the best technical advice procurable should be obtained. More geological information is required regarding the glauconite zone, the nature and thickness of underlying formations and the floor upon which they rest. Tertiary formations outside the Lakes Entrance area require special and more adequate exploration than is at present the case. Geophysical methods would facilitate this work.

Finally, in view of the present demand for oil of all kinds, Sir Edmund maintains that the undertaking should enlist the support of the Government and of private enterprise. Moreover, there is an urgency in the matter which calls for the immediate speeding-up of activities in this direction.

ORIGIN OF THE EGYPTIAN CALENDAR

THE calendar of the ancient Egyptians was one of the earliest experiments in calendar making, and it was one of the most enduring. It was still in use at the beginning of the Christian uch as it had been in the Pyramid age thre years before, having had an uninte ence throughout more than half of ma e. Many theories, all differing fu put forward as to its o recently by H. F Ancient Egypti sophical Soc., 83, No. 3; 1940), introducing a further suggestion as to the natural phenomena which first marked the changing seasons for the ancient Egyptians and came to be the foundation of their calendrical system.

The approach to the problem has usually started with a statement by Censorinus in A.D. 238 that the Egyptian New Year Day in A.D. 139 fell on July 21 when the bright star Sothis (Sirius), after having been invisible for a season, made its annual reappearance the eastern sky just before sunrise. Since the

Egyptian civil year was one of 365 days and the Sothic year was one of 365¼ days, this coincidence could have happened only at intervals of about 4 × 365 years or in 1317, 2773 and 4231 B.C. At the two earlier of these dates (assuming that 2773 B.C. fell in the Fourth Dynasty) the calendar was already in use; and hence Edward Meyer, in 1904, concluded that the calendar must have been introduced in 4231 B.C., since its introduction was possible only on the occasion of a coincidence of the opening of the Sothic and the calendar years. This dating, however, relegated the origin of the calendar to distant prehistoric days, long before King Menes, the first historical king who united the two lands of Egypt, and dated by Meyer himself at 3200 B.C.; consequently it involved the uninterrupted use of the calendar for a thousand years before the use of writing began.

The difficulties in the way of accepting such a conclusion led to numerous modifications of Meyer's theory by Breasted and others; but in recent years the tendency has been toward the more reasonable hypothesis that the calendar was the product of some later period. One of the most ingenious schemes for avoiding the difficulty is that of Prof. Jotham Johnson, who argues that the Egyptians had a lunar calendar until June 18, 3251 B.C., when the heliacal rising of Sothis coincided with a new moon. From that day the calendar was fixed to Sothis, but gradually became so far divorced from the terrestrial seasons that by June 18, 2773 B.C., a whole four-month season's correction was necessary and it was abandoned for the wandering year of the historic period. Another suggestion is that of Alexander Scharff, put forward in 1927, which attributes the invention of the calendar to 2773 B.C., but assumes that before then time was reckoned by an entirely different system, based, it would appear, on a year of 320 days. O. Neugebauer, however, had suggested that observation of the Nile flood over prolonged periods would give by averaging a year of 365 days without the observation of any heavenly body whatsoever, and this, Scharff holds, supplies evidence of the nature of the calendar in use before 2773 B.C. and possibly so late as 2000 B.C.

In this connexion it is pointed out that, certain modern studies on the Egyptian calendar notwithstanding, the whole history of a year with intercalations is a history of an innovation obnoxiously foreign to the native Egyptian; and there is no hint in the whole four centuries and a half covered by the classical literature that the Egyptians had any memory of ever having used a fixed year or of ever having recognized its desirability.

The calendar of the historic period gives clear evidence that it originated in the climate of the land. In this rainless climate all living things in the Nile valley have been dependent on the Nile flood. The river is at its lowest at the First Cataract about the end of May and at the head of the Delta some two weeks or more later. Soon after the level begins to rise, reaching its height at the First Cataract about September 1 and a month later at the Delta head, where by the middle or end of October the highest flood lands begin to emerge and the waters fall until they reach their lowest again in the following June.

From the palæolithic period onwards the occupations of the inhabitants, whether hunting, fowling and fishing, and pasturage when they acquired domesticated animals, or cultivating the seeds they had learned to save from the last low Nile—all these occupations were profoundly affected by the fluctuations of the Nile. In the season known later as *Akhet*, 'the [illegible] settlements on the [illegible] waters fell, *Proyet*, '[illegible] they followed the retre[illegible] plain; and in *Shōmu*, [illegible] meaning 'the harvest ti[illegible] and the permanent swamp[illegible] flood. Thus the ancient E[illegible] three seasons, and when he ad[illegible] he chose a form of *ronpy*, 'to b[illegible] as of plants, considering the year a[illegible] first signs of the rising water which [illegible] the verdure once more.

By the time stone age man felt the ne[illegible] other means of predicting the future sta[illegible] river, probably in connexion with the opera[illegible] agriculture, he must already have become accust[illegible] to counting the phases of the moon—with the ris[illegible] Nile four moons to the time of sowing, then four moons for the grain to ripen, and a third four moons before the flood would appear again. Notwithstanding the error in a lunar year of 354 days, and irregularities in the flood itself, the moon would serve as a practical rule of thumb. Traces of the lunar reckoning survived under a more practical calendar in the subdivision of the year into twelve parts, each called by the name of the moon, *abou*, as in our months. About 1850 B.C. lunar months of alternatively 28 and 30 days served for priestly temple service. Traces appear in religious calendars down to Roman times and the king was crowned on the day of the full moon. In 1100 B.C. astronomical tables still had a technical term for the mid-month derived from the time when a month was a moon and the mid-month was full moon time.

Lunar reckoning, however, was always of secondary importance for the Egyptians; and while other lunar calendars count each day from sunset, the Egyptians alone of all ancient peoples commenced their day at dawn and the same ideogram stood in their system of writing for "sun" and "day". Nevertheless the Egyptians never adopted solar seasons. Their seasons were always those of the Nile. Only for a brief period in the fourteenth century B.C. did Egyptian beliefs give full credit to the sun for its controlling influence on terrestrial life. It was only in classical times that the solstice was an omen of the coming inundation (*cf.* Herodotus and Pliny).

The rise of the Nile and lunar reckoning proving unsatisfactory as a means of time-reckoning for a people becoming more and more cultivated, and, the sun seeming to have no connexion with the question, the Egyptian, like other primitive peoples, turned to the sky for a sign that his new year was approaching. For this purpose he chose the heliacal rising of Sothis, which about 7000 B.C. was visible at the head of the Nile delta round about May 21 and in 3500 B.C. on June 17, and by 2800 B.C. on June 23. The later it came the more certain it was to be regarded as a harbinger of the flood. So early as the dawn of the historic period, that is, at the time of Menes, the Egyptian was already regarding Sothis as the harbinger of the all-important inundation. This is shown by a primitive ins[illegible]ion on an ivory tablet from a royal tomb at A[illegible]hich Sothis is called "Bringer of the New [illegible] the Inundation" and in a Pyram[illegible] te[illegible]f all green growing things [illegible] Thus the association wa[illegible] [illegible]he official observation [illegible]is to be noted, took [illegible] by Menes.

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A WORLD PLANNING COMMISSION

THE twenty-five anonymous authors of the Penguin Special "Science in War" (see NATURE, July 27, p. 112) succeeded not only in presenting a review of a few of the many services rendered by scientific men in the present conflict, but also in leaving the impression of vast potential forces insufficiently co-ordinated or inadequately marshalled. Certainly many men of science in Great Britain feel that more direct use might be made of their special knowledge. It may be, as Dr. C. H. Desch has said, that "advisory committees of independent scientific men are appointed by many Government departments, but they rarely have the power to discuss policy, and still less often to make decisions, so that their work is liable to fail of its effect or to be subject to an unnecessary time-lag". On the other hand, there has been a growing realization that part of the blame rests with scientific men themselves, for many have shown lack of appreciation of, even a lack of interest in, the social consequences of their own work, so that it is left to the administrator to formulate plans and make practical applications of scientific discoveries or to set right dislocations of a slowly evolving social structure which a too rapid succession of discoveries inevitably causes.

During the meetings of the Eighth American Scientific Congress held in Washington, D.C., during May 10–18 last, several papers on the conservation of natural resources and allied topics were discussed, and the following resolution was passed :

> "WHEREAS : Needless waste and destruction of necessary natural resources everywhere threatens or will threaten, sooner or later, the welfare and security of peoples ;
>
> Throughout human history the exhaustion of these resources and the need for a new supply have been among the greatest causes of war ;
>
> The welfare of every nation requires natural resources which it lacks, and fair access to such resources from other nations is an indispensable condition of national welfare and permanent peace ;
>
> Conservation of natural resources and fair access to needed raw materials are steps toward the common good to which all nations must in principle agree ;
>
> International cooperation to inventory, conserve and wisely utilize natural resources to the mutual advantage of all nations might well remove one of the most dangerous obstacles to all nations to a just and permanent world peace ; and
>
> An Inter-American Conservation Commission representing all the American nations would be of great and lasting value to the Americas, and through them, to all the nations of the world by advancing the knowledge of the natural resources of the earth, by promoting mutual access to necessary natural resources, and by bringing nearer the permanent removal of one of the greatest causes of war,
>
> The Eighth American Scientific Congress
>
> RESOLVES : To recommend to the Governments of the American Republics the appointment of an Inter-American Conservation Commission cooperating with the Pan American Union and representing all the Americas.
>
> That this Commission be charged with the duty of preparing an inventory of world natural resources, and of formulating a general policy and specific program of action to promote the mutual conservation and prudent utilization of natural resources for the welfare of all nations, in the interest of permanent peace."

This resolution is of fundamental interest for several reasons, but particularly because it recognizes the obligation of a single Commission to bridge the gulf between its own findings and their practical application.

Actually this ambitious project is but an extension of the procedure which has been tried out in the United States. There, after a small and tentative beginning, the National Resources Board was created as part of the Roosevelt 'New Deal' legislation by executive order on June 30, 1934, and charged with the tasks of preparing a detailed inventory and a general plan for the use of the nation's resources. In the following year a Bill was presented in the Senate for the establishment of a permanent National Planning Board. Thus the great work of reconstruction and conservation has been based on the survey initiated by Delano (uncle of the President), Wesley Mitchell and Charles Merriam, with Charles Elliott III as their organizing secretary.

The scope of the prospective world-wide inquiry may be judged from the elaborate and voluminous reports of the National Resources Board. These have been epitomized for the general reader in an unofficial volume by twenty-two authors entitled "Our Natural Resources and their Conservation" (New York: Wiley, 1936). Its ten parts deal respectively with the history of the conservation movement, the conservation of the land and its soil, forests and timber, water supply and power, minerals, wild life, recreational resources, man, the relation of conservation to industry, local, State and national planning.

With the advantages of a common tongue, a unified government control and a uniformly high standard of education, the survey of the resources of the largest free-trade area in the world was in the main a collecting of material already available. The extension of such a survey to all the American republics, and still more to the world as a whole, obviously bristles with difficulties. In the dictator countries, both the knowledge and the planning based thereon are the prerogatives of the *Führer* or *Duce*; in the communist organization, it is the State which nominally formulates and controls its 'five year plans', based on information unavailable outside official circles immediately concerned. Among the democracies, so long as there is free competition and the stimulus of reward to individual effort, much of the essential information is jealously guarded by those individuals or corporations who have worked or paid to possess it. For example, immense sums of money have been spent in exploration work by the great oil companies in all parts of the world: they tend to maintain a close secrecy over the results.

The surmounting of such difficulties is a major task of the Commission: the important point is that the resolution is a practical expression of the ideals of the democratic way of life. These are the ideals for which the British Empire is fighting, and the scientific workers of the Empire should surely associate themselves with the lead thus given by the American Scientific Congress. That the New World has initiated the move should not be a source of jealousy in the Old World torn by strife, but rather a source of inspiration that democracy is a living force with a plan for the future.

MOLECULAR SPECTRA AND MOLECULAR STRUCTURE

Molecular Spectra and Molecular Structure
1: Diatomic Molecules. By Prof. Gerhard Herzberg. Translated with the co-operation of the Author by Prof. J. W. T. Spinks. (Prentice-Hall Physics Series.) Pp. xxviii + 592. (New York: Prentice-Hall, Inc., 1939.) 6·50 dollars.

DURING the last two decades great progress has been made in the experimental study and theoretical interpretation of molecular spectra, which has thus become one of the most important means we have for investigating molecular structure. There is, indeed, no experimental method that gives more detailed information on this subject. From the spectra, the discrete energy states of the molecule, as well as the limits of energy continua, can be derived directly. From these in turn we can draw precise conclusions concerning the orbital motions of the electrons, and the vibrations and rotations of the nuclei. As to the electronic motion, we may learn its quantal type, including its symmetry and arrangement of nodes; we may deduce its energy as a function of the inter-nuclear distances, and its angular momentum; and we can evaluate any associated angular momentum due to an unbalanced relative orientation of electronic spins. This information has led to a deeper theoretical understanding of chemical bindings. As to nuclear vibrations, we can learn their frequencies, calculate the forces between the atoms, and derive also the energy required to bring about dissociation, as well as the dependence of the dipole moment and polarizability of the molecule on inter-nuclear separation. From rotational data we can derive very accurate values for the inter-nuclear distances, and in special cases obtain information concerning the spin and statistics of the nuclei. The detailed and quantitative knowledge of molecular constitution thus obtained leads, in its turn, to the possibility of calculating certain properties of matter in bulk ; for example, in the fields of magneto-chemistry and thermodynamics ; the total energy, free energy and specific heats of many gases can be derived more accurately from spectroscopic data than by direct thermal measurement. Other achievements of molecular spectroscopy in the chemical field include the detection and characterization of many molecules, radicals and ions, C_2, He_2, Na_2, OH, CP, H_2^+, HCl^+ and some hundreds of others that were not previously thought capable of free existence, the elucidation of elementary chemical reactions, and the prediction of chemical equilibria.

All this is so much in the spirit of modern physical chemistry, and yet so difficult a field for the novice to enter, that the appearance of a comprehensive text-book in English on the subject by Prof. Herzberg is an event of considerable importance. It will undoubtedly accelerate the future development of physical chemistry ; for there could be no better teacher of spectroscopy and its applications than Prof. Herzberg, and no better instrument for the translation of his writings than the collaboration of his colleague Prof. Spinks and himself. In the earlier book "Atomic Spectra and Atomic Structure", which was written and translated in the same manner, we became familiar with that singular clarity of style which makes learning a pastime and renders a comparatively short text both suitable to beginners and sufficiently comprehensive to assist the research worker. The new book, which is an extension of, and improvement upon, the original German text, has all the simplicity and crisp directness of the old ; and it goes definitely further in the direction of comprehensiveness. It deals only with diatomic molecules, but the author says in his preface that a further volume on polyatomic molecules "will follow as soon as possible."

In order to assist the beginner, certain sections of the text, which are not necessary for an understanding of the fundamentals, are printed in smaller (but not small) type ; while, for the sake of the research worker, an extensive bibliography is given, as well as a number of valuable tables, and diagrams to scale of energy levels and potential curves. One table gives the molecular constants for the ground states of all the diatomic molecules investigated up to July 1939. The research worker will also be glad to find descriptions of procedure, such as the procedure for analysing a band system, or an individual band, locating and identifying energy states, or tracing the potential energy curve for an excited state from intensity variations in continuous absorption. The very detailed subject index, which also contains all terms, symbols and quantum numbers, should be useful both to the beginner and the research worker.

As the author remarks, it is not possible nowadays to give a satisfactory presentation of the subject of molecular spectra and molecular structure without treating thoroughly, apart from the empirical results, the theoretical background also. He has therefore included as much of the theory of molecular spectra as is possible without complicated mathematics. This means, for example, that the general method of deriving selection rules is explained ; that all the selection rules which can thus be derived are stated ; but that the actual derivation of these rules is carried through only in a few cases, chosen for their mathematical simplicity. On the other hand, a large number of diagrams serve to illustrate and explain the theory, and throughout contact is kept, by the aid of numerous spectrograms, some taken specially for the purpose, with the experimental material that forms the basis of the subject.

The general plan of the book is as follows. A résumé of the elements of atomic structure is succeeded by a description of observed molecular spectra. There follows an account of rotational and vibrational, infra-red and Raman spectra. The main centre portion of the book is devoted to electronic band spectra, leading to the discussion of building-up principles, electron configurations, valency, dissociation, and pre-dissociation. A final chapter describes a number of applications of band spectroscopy to other fields of physics and chemistry, and to astronomy.

The congratulations and thanks of the scientific public are due, not only to the author and translator, but also to the editor of the series, Prof. E. U. Condon, and to the publishers, Messrs. Prentice Hall Inc. In reading the work for the purpose of improving a course of university lectures—more than a casual reading, that is to say—I have noticed very few misprints, none of them serious. The printing is excellent, and the numerous scale diagrams reveal a high standard of draughtsmanship. The paper throughout is so good as to be quite suitable for the spectrograms and diagrams, although many of these are peculiarly rich in detail ; thus the necessity for 'plates' is avoided, and the reader secures the advantage that the illustrations appear along with the text to which they relate.

Prof. Herzberg's book will be assured of a grateful reception, and we shall eagerly await the promised sequel on the spectroscopy of polyatomic molecules. C. K. INGOLD.

SAILING THE SKIES

Flight without Power

the Art of Gliding and Soaring. By Lewin B. Barringer. Pp. ix + 251. (New York and Chicago: Pitman Publishing Corporation; London: Sir Isaac Pitman and Sons, Ltd., 1940.) 17*s.* 6*d.* net.

THE title of this book is "Flight Without Power", but when Chapter vi has been read one comes to realize the tremendous sources of energy that are available to the pilot of soaring craft, and in fact this chapter, which is entitled "Soaring Meteorology", commences with the sentence, "The *power* required for soaring is not derived from any power plant carried by the craft, but has to be taken directly from the energies available in the atmosphere".

"Soaring Meteorology" is contributed by Dr. Karl O. Lange, an authority on the subject, and the chapter is dealt with first in this review, as it is certainly the 'kernel of the nut'. It is well written and is perhaps the most clear, concise and up-to-date exposition on the structure of the atmosphere that has yet been specifically written for the sky-sailing pilot.

When wind is forced to pass over a hill an up-current is provided, and this will support the comparatively lightly loaded glider having a sinking speed no greater, or less than, the upward component of the air, but the pilot is constrained to remain within a relatively small area if he is to retain his height. On the other hand, thermal up-currents are formed in wide distribution over the earth's surface, so that by making use of these the sailplane is free to move in any desired direction, and moreover much greater heights may be attained by this means. As a 'bubble' of hot air detaches itself from contact with the ground, it is caused to rise on account of its decreased density relative to the surrounding air and continues to rise, losing heat on its upward journey due to expansion, until it possesses no excess temperature. But the temperature of the air through which it rises also decreases with height and so tends to accentuate the temperature difference, and so increase the height to which the thermal climbs. This falling off of air temperature with height is known as 'lapse rate' and is of importance to the soaring pilot equal only to that of the wind velocity for the sailing boat. Dr. Lange shows that there are five possible standards of lapse rate, but for successful soaring flight the lapse rate must be unstable, that is to say, the air temperature must fall off by more than 1° C. per 100 metres, the amount by which the air 'bubble' temperature falls off with height. In a lower lapse rate it is obvious that the ascending current would soon lose its momentum and fade. The moisture, or water vapour, carried up in the thermal bubble condenses at a certain height (temperature), depending on the amount of vapour present, since the saturation capacity (dew point) of cold air is less than that of warm air. Thus the well-known cumulus clouds are formed, and they supply the pilot with sure signposts to the presence of ascending air currents. The chapter is well illustrated with cloud pictures and diagrams, and includes much useful information on how best to utilize the clouds and what types to treat with full respect.

The author of this volume is Lewin B. Barringer, one of America's foremost sail-plane pilots and the holder of the coveted 'Silver C'. Apart from considerable flying experience of both soaring and power aircraft, Mr. Barringer for some time managed the Wings Glider School, and therefore writes with knowledge of club organization and instruction. It might be more correct to refer to him as editor instead of author, for although seven of the twelve chapters are written by his pen, 122 of the 223 pages are contributed by others. Chapter i deals with the history of motorless flight and is written by N. H. Randers-Pehrson. "Aerodynamics", written by Paul Schweizer, is interesting and should prove useful, but it is rather slovenly put together and contains several mistakes (mostly careless typographical), and some of the symbols become changed as the chapter proceeds. Paul and Ernest Schweitzer contribute a lengthy chapter on "Design, Construction and Maintenance", but it is chiefly descriptive, and to some extent lacks 'meat'. It does, however, include some interesting details of the "Meise" sail-plane that was chosen as the standard design for the projected 1940 Olympic international competitions.

A brief, but somewhat sketchy, chapter by C. H. Colson is devoted to instruments. Certain basic principles, such as the measurement of air pressure by a Pitot tube, and the action of the gyroscope, are assumed to be known; but if such facts are known by the reader it is likely that a rough idea of the functioning of the various instruments is also known.

The author deals in Chapter iii with types of gliders. Launching methods are fully covered in Chapter v, much useful information being contained therein. "Towing Methods" are ably described in Chapter x, but the preference for automobile towing for training purposes, in place of winch towing favoured in Great Britain, is a little surprising. Chapter xi, on "Soaring Technique", based largely upon the author's own experiences, is full of interest. "Soaring Sites" and "Clubs" are the titles of the next two chapters, followed by the "Future of Gliding and Soaring", which but lightly touches on the future and is a trifle disappointing.

The book concludes with an appendix giving a list of soaring pilots, contest statistics and table of records, together with biographical sketches of the first ten American 'Silver C' pilots. A bibliography, glossary and index are also included.

In conclusion it can be said that "Flight Without Power" is essentially a book for the potential cross-country sail-plane pilot, and as such it can be recommended as one of the best volumes yet produced.

C. H. LATIMER-NEEDHAM.

THORPE'S "DICTIONARY"

Thorpe's Dictionary of Applied Chemistry
By Sir Jocelyn Field Thorpe and Dr. M. A. Whiteley. Fourth edition (revised and enlarged). Vol. 4: Digallic Acid—Feeding Stuffs. Pp. xxiii + 604. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 70*s*. net.

SINCE this section of the fourth edition was sent to press one of the editors, Sir Jocelyn Thorpe, has died. It is sincerely to be hoped that the remaining editor will be able to continue the work on her own or will be able to find someone to help her in the tremendous task of revision.

At this juncture it is opportune to direct attention to the format of the title-page. No indication is given therein of Sir Edward Thorpe's editorship of previous editions, nor of their dates, and the younger generation might well be excused for thinking that Sir Jocelyn Thorpe was responsible for them, whereas, in point of fact, there was no relationship between the two men.

The longest article in this section is by the late H. Shankster on explosives, in addition to one on dynamite. No cross-reference is given under nitro-hydrocarbons to "Benzene and its Homologues, Nitro Derivatives", in vol. 1. This omission is perhaps just as well, since the latter contains a drawing of a nitration plant which is certainly not used for explosives. Rumour has it that the plant was designed by a young man without experience in the subject, and the design was afterwards adopted in an emergency plant near London at the beginning of the War of 1914–18, only to result in the plant being blown up owing to faulty planning of the cooling coil which was inadequate to control the heat emitted by the reaction. Whether the rumour be false or only partially true, it does illustrate the fact that the utmost care is needed in the selection of contributors to ensure that the subject-matter is beyond reproach.

Previously, the subject of "Dyeing" and "Identification of Dyestuffs on Fabrics" were separate articles. These are now combined into one under the pen of Ellis Clayton, and "Dyestuffs, Azo", is by M. Lapworth.

Welcome additions, which were not in the previous edition, are well written, and include concise articles on "Industrial Dust", by J. A. Holden and "Dust Explosions", by T. N. Mason. It would have been interesting, however, if the section on the physiological effects had been expanded, especially as regards silicosis. For the safety of workers in the chemical industry, a dictionary such as this one can prove of inestimable help in providing ample and adequate information and reduce those casualties due mainly to lack of knowledge. In fact, any toxic chemical should have a section included on its physiological effects and means of overcoming them.

On the subject of distillation there is an article by J. Reilly and D. F. Kelly on laboratory practice, since the industrial aspect is being dealt with under the heading of "Stills". This article is mainly concerned with the physical chemistry of the subject and does not include the questions of number of theoretical plates and column liquid hold-up; the essentially practical aspect of the subject developed by Podbielniak and others is not mentioned. This is to be regretted, since the practice of laboratory distillation is often little understood by the majority of organic chemists.

"Emulsions and Emulsification" makes its first appearance, and includes line drawings of emulsifiers and a list of recent patents on the chemical side. It is by A. King.

The chemical engineering aspects are covered by "Drying", by S. G. M. Ure, "Evaporation", by J. A. Reavell, and "Extraction", by W. Peck. The article on drying is new, and is a valuable addition. It deals with the various commercial types of plant, which are illustrated in a clear manner, and convey the essentials at a glance. The references are comprehensive, and no doubt explain the absence of drying theory, which is still in a somewhat transitory state. The photographs in "Evaporation" do not convey much information and could be omitted; little is given on heat transmission and general theory, and no references are included to help the reader to find this information for himself. "Industrial Extraction Apparatus" contains much that is new, especially with reference to sugar beet. Here again, one of the photographs of a thickener could very well be dispensed with.

The general impression left by this volume is that the editors and contributors are to be congratulated on the excellence of their articles, and that if there is, here and there, some scope for criticism, it is almost unavoidable in a work of this nature.

ECONOMICS OF PRIVATE FORESTRY

Economics of Private Forestry
By Prof. Ralph W. Marquis. (American Forestry Series.) Pp. viii +219. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 18*s*.

THE forestry question is indisputably one of extreme importance in the United States, as the increasing number of books on the subject testify. Some of these have been published in the American Forestry Series of which Walter Mulford is consulting editor. One of the latest is a volume dealing with the economics of private forestry by Dr. Ralph W. Marquis, assistant professor of economics, University of Rochester, New York, which is original in treatment.

As the author states, he is not a professionally trained forester, and his economic views at times run counter to accepted dogmas of the latter. As this book well shows, and is apparently designed to show, the forestry problem in America is to some extent overshadowed by the lumber trade and its interests; a position which probably does not exist to the same degree elsewhere in the world with the exception of Canada. In Britain when we talk about private forestry we allude chiefly to the private landowner, for few public bodies (with a notable exception or two) have interested themselves in the matter.

A perusal of Dr. Marquis's book proves that he is envisaging the matter from the angle of private interests, such as the capital locked up in the lumber companies, the farmer's woodlots, etc. Owing to the serious decrease in the forests and their supplies in the country, due to the gigantic fellings often accompanied or succeeded by devastating fires of the last eight decades or so, serious attention is being given to the future of the lumbering business and the successful marketing of timber from privately owned forests. It may be pointed out that these present only one aspect of this great problem in the United States. The author writes: "Ever since the days when the first Colonists landed on American shores our forests have presented a problem, but the problem has not remained static. As the nation has developed and population has increased, as the forests have been cut down, as homes and factories have been built and farms developed, as all our social and economic relations have changed and become more complex, so has the problem of the proper treatment of our forest resources changed and become more complex."

To the forester this reasoning appears difficult to follow. Many countries in the world have been faced with, or are facing, similar experiences. It is no new problem to the forester; and it is difficult to see why it should prove one to the economist. Demand for forestry produce went up by leaps and bounds in the United States, and the forests provided for the demand and paid the price. What was once regarded as an inexhaustible capital has shown itself to be far otherwise. It is true, as Dr. Marquis says, that many statements have been made on this forest problem and many conflicting solutions offered. In a different degree and from somewhat different angles the same is true for the many types of forests within the confines of the British Empire, not excepting Great Britain. But the answers are broadly the same. What has been utilized or destroyed must be replaced. Capital will be required and perhaps some form of Government legislation, as the author suggests.

In the more undeveloped countries or in those where under the land tenure system in force the State is the greatest landowner, the latter will be the chief forest owner and manager. But in all highly developed States it is recognized that forestry is at its best when State, corporation, town, and even village, with the private landowner in addition, all take a hand in owning and maintaining the area of forest economically necessary for the requirements of that country—so far as these may be provided from the area available for this purpose. These are the broad principles. Dr. Marquis, in directing attention to existing private vested interests, appears inclined to consider that these latter should undertake the chief part in the forestry problem, the State serving as a benevolent godfather. But Prof. Westveld has shown that the National and States' forests already amount to an area of some 169 million acres, and that the former at least will be considerably increased from the area of approximately 432 million acres still in private ownership. It would appear that there is work for all categories of ownership, the central Government giving the lead.

E. P. STEBBING.

PSYCHOLOGY AND HUMAN VALUES

Nouveau traité de psychologie

Par Prof. Georges Dumas. Tome 6 : Les fonctions systématisés de la vie affective et de la vie active. Pp. 546 + iv. (Paris : Félix Alcan, 1939.) 125 francs.

THE topics dealt with in this volume lend themselves to lengthy and detailed discussion in separate essays, and adequate criticism would necessitate a study of each article in detail. In that case criticism would probably become controversy, since the writers are mostly concerned with highly theoretical issues. Let us say at once that it maintains the high standards of its predecessors alike in the style and quality of its contents and in the excellence of its production. Though the whole work has now grown to dimensions which cause the eyes of busy readers to turn affectionately to its two-volume predecessor, we hope that the remaining volumes will not be too long delayed by the War. Furthermore, it is surely in order to salute our French colleagues and to tender our sympathy and good wishes. The volume under review is a reminder of how much we owe to French psychologists ; probably it could have been produced in no other country. But let one of the volumes be an adequate index to the whole.

The present volume is very reminiscent of the psychological treatises of an earlier day, factual knowledge being less prominent than detailed theoretical discussion and criticism. It is richly informed by recent writings and amply documented ; but more note might have been taken of the work of the pioneers who have tried to break ground in these stubborn fields by experimental methods. A treatise of such scope is incomplete if it does not take full account of the work carried out by Americans in this field, even if the writers think that it only touches the fringe of the subject. English readers may think that less than justice is done to the views of McDougall and Spearman. The present writer believes that the future lies with those who follow the experimental path, even though the results are at present modest. When Prof. Delacroix boldly attacks "Les Sentiments esthétiques et l'Art" and "L'Invention et le Génie" the main result is to show how little can be said authoritatively on the greater values of human life. Nevertheless, a discussion of such problems is profitable when conducted with such clear common sense as the author brings to bear upon them. In fact, the volume is distinguished throughout for hard common sense and insight into the higher levels of man's emotional life. These qualities are shown in the acute criticisms of theories more pretentious than these writers are prepared to offer. While it may be thought that "L'Évolution, la Spiritualisation et la Socialisation des Tendances" are not yet ripe for strict scientific treatment, psychology will profit by the reminder that it has to take them up. The whole volume is a reminder that psychology deals with real and living human beings.

The qualities mentioned are well exemplified in the chapter devoted to volition (Ch. Blondel). The experimental work is fairly discussed and put on one side as unlikely to attain important results by reason of the triviality of the material used ; it is concerned with children's games rather than with true volition. The data secured are only made intelligible by a study of moral choice, thus reversing the intention of the researches. To this it may be replied that the triviality of the material employed in experimental researches does not make the results trivial. The students criticized would be content if they could claim that they had clearly demonstrated this or that feature of volition. Prof. Blondel is too exclusively concerned with moral choice. Not all volitions are on the heroic scale. Even the decision to buy a hat, or to call two spades, deserves analysis, and probably these simpler cases will reveal the central factors present in all volition. But, having entered this protest, we are free to enjoy the broad wisdom and humour of the author's treatment. Like his colleagues, he restores the balance which may be disturbed by deriving wider conclusions from experimental data than they really justify. In this chapter (as throughout the volume) emphasis is laid upon social factors, though much more analysis will be required before the appeal to them can be decisive for psychological theory.

A. W. P. WOLTERS.

SOME RECENT ADVANCES IN DAIRY SCIENCE[*]

BY PROF. H. D. KAY, O.B.E.
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COMPOSITIONAL QUALITY OF MILK

ALTHOUGH many mammals other than the cow have been used by man for milk production—in Great Britain we have some 120,000 milking goats at present, and both here and elsewhere sheep, mares, asses, camels, buffalo and deer have been used for producing milk for human consumption—when we speak of milk we usually mean cows' milk.

In war-time, when our diet tends to be restricted directly or indirectly owing to enemy action, the place in the dietary of cows' milk, valuable as a source of vitamins, lime and animal protein, increases relatively in importance. Produced entirely at home and produced to an extent which is less dependent on imported foodstuffs than is usually realized (some 84 per cent of the food of the dairy herd is produced in Great Britain) cows' milk is undoubtedly one of the key food products the supply of which must be maintained by every means in our power. This has been consistently recognized by the Government, which places the dairy cow as '*farm animal, No.* 1', and hopes to be able to meet at least 90 per cent of its pre-war requirements of imported food by restricting the supply to animals of less immediate importance. A tight, well-thought-out rationing scheme is the only way to meet this priority with the minimum of hardship to feeders of other stock.

From the national point of view, and the consumers' point of view, in war-time or in peace-time, but particularly in war-time, there are two separable but related factors in the maintenance of the milk supply—volume and quality. Volume can be measured by the consumer, quality is less readily assessed. Since at present milk is sold entirely on a volume basis, it is not surprising that what concerns the farmer is mainly milk yield—how many gallons he can obtain from a given expenditure of time, labour and feeding-stuffs. But the purchaser of milk, both the milk manufacturer who intends to make cheese or butter from it, or to dry it, and the liquid consumer (though the latter usually does not realize it) are also concerned with milk quality and composition. The food value of the same volume of milk from different cows, or the same cow fed different foodstuffs, is not always the same, though it is true that the usual variation between one *normal* cow and another is not great. Our trouble at present is that too small a proportion of our cows are normal. In practice it is found that between one individual and another, and even between the mixed milk of one herd and that of another, there may be variations of real nutritional importance. Variations in the food value of the same volume of milk as great as 15–20 per cent or even more are not infrequent, though the appearance of the milk and its price to the buyer or the consumer may be the same.

TABLE 1.

LOSS OF GROSS NUTRITIONAL VALUE IN LOW-QUALITY MILK.

	Percentages			
	Fat	Non-fatty solids	Total solids	Water
Typical good herds	4·05	9·00	13·05	86·95
	3·75	8·95	12·70	87·30
	3·80	8·85	12·65	87·35
Poor herd	3·05	7·85	10·9	89·1
Poor individual cow	2·50	7·45	9·95	90·05
Loss in food value as between good and poor herd ..	about 30%	about 11%	about 24%	—

What are the causes of these variations ? Can they be controlled ? The organized farmers of the country have shown their anxiety to have these problems solved, and the manufacturers of milk, for obvious reasons, would prefer to have the milk reaching them of more uniformly satisfactory composition. It is a matter of national importance in peace-time, and in war-time of even greater importance to establish these causes, so that we can maintain our milk supply at the highest possible nutritional value.

As a result of extensive investigations during the past few years, the main causes are fairly clearly established, though control of these causes is not so far advanced as could be wished. The following are the main factors concerned, put in probable order of present importance. The relative importance varies from one season of the year to another, and probably from one year to another :

Udder disease, even in the sub-clinical stages.

Feeding of insufficient supplementary food, particularly in late summer, usually associated with drought.

Breed differences.

Physiological disturbances, unassociated with disease in the ordinary sense, probably due to hormone imbalance.

Adventitious watering.

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[*] From a discourse delivered at the Royal Institution on November 19.

There are, of course, minor causes which affect individual cows—for example, end of lactation milk, which is often a little abnormal in composition—but the main causes of low-quality milk are undoubtedly those just mentioned.

Udder Disease. This is at present the principal cause of inferior quality milk. The chief trouble is mastitis—an inflammation of the udder which may vary from very mild to very severe in intensity, and is usually due to infection with a specific streptococcus, *Str. agalactiæ*. It is usually accepted that this particular organism is not pathogenic to the human consumer, even if he drinks the infected milk.

It has been known for a long time that mastitis diminishes milk quantity, and that severe or acute mastitis diminishes milk quality. The main addition to knowledge in the last few years is that udder infection of this type may affect compositional quality quite as seriously, and do so even before the diseased state of the udder becomes patent to the expert eye. In an investigation we carried out some three years ago extending over twenty-nine good commercial herds, mastitis infection was found on bacteriological examination in at least 61 per cent of the animals which yielded low quality milk. Practically all these cases were cases where the disease had not proceeded far enough to be obvious on expert examination of the udder, though a simple examination of the milk would have revealed many of them. It is now known that the test we employed misses quite a number of positive cases, though it does not show any false positives. Hence 61 per cent can be regarded as a minimum estimate; the truth will be nearer 80 per cent.

It has been calculated that mastitis causes a fall in our national milk yield of some 6–7 per cent. I am not too happy about the basis of this calculation, though I believe the result is not far from the truth. If we assume a loss of only 4 per cent in volume, the producers of Great Britain are losing not less than £2,500,000 each year as a result of this loss of milk. There is, in addition, the loss of milk *quality* and food value, so that our figure of £2,500,000 may be taken as a highly conservative estimate of what the nation is paying annually for this disease. We are spending less than £5,000 annually in research on methods of dealing with it.

In war-time this loss of milk and of food value is one we can particularly ill afford. Fortunately the researches of the past few years, parsimoniously supported though they have been, have yielded new information which shows that if a farmer is willing and financially able to take certain simple steps, he can achieve a great measure of control over the severity and spread of the disease in his herd. Though at present he cannot, unfortunately, eliminate it completely, he can, by the regular examination of milk from every quarter of each of his cows, using a simple method which can be carried out on the farm, followed by partial segregation of infected and suspected animals and veterinary help with the treatment of clinical cases, effectively control it, so that yield and quality of milk from his herd will steadily improve and eventually return to the normal. An essential part of the control scheme is the careful disinfection of udders, of milkers' hands, and of parts of milking machines that come in contact with the cow, with dilute hypochlorite solution. Another is the avoidance of rough handling, over-stocking and the misuse of milking machines.

Some of us think that now is the time to apply this knowledge on a national scale. It could scarcely fail to increase appreciably our milk supply, which at present, from a variety of causes, is tending to flag.

Poor Feeding. The feeding of insufficient concentrates has been clearly shown, by controlled examination of data during the last few years, to be another important factor in the production of poor quality milk. Such feeding also obviously affects milk yield. In war-time, with diminished supplies of imported concentrates, this difficulty is not easily overcome; but it must not be assumed that *imported* concentrates are the only foods which will help matters. Home-produced food, with a reasonably good protein content, or even good hay or silage, will help appreciably to maintain both yield and quality in conditions of drought. If more farmers had taken to heart the research findings of the last two decades in improvement of grassland, in the use of the plough on old pastures, in types of grasses to be grown and in methods of management of grassland, the stock-bearing and milk-producing capacity of large areas of Great Britain would have been greatly increased, and our dependence on imported concentrates diminished.

Breed of Cow. It is well known that normal cows of certain breeds such as Friesians and Shorthorns tend to give milk that is somewhat lower both in fat and non-fatty solids than cows of other breeds such as Guernseys or Jerseys, Ayrshires being intermediate.

Table 2.

Breed	Fat	Solids-not fat	Protein	Ash	Water
Jersey	5·1	9·6	3·8	0·75	85·3
Guernsey ..	5·0	9·55	3·8	0·75	85·5
Ayrshire ..	3·85	9·05	3·3	0·69	87·1
Shorthorn ..	3·6	8·95	3·3	0·73	87·4
Friesian	3·45	8·5	3·1	0·68	88·0

The average difference is not very great with typical healthy animals of the different breeds; but it is still quite appreciable, and a gallon of average Jersey milk undoubtedly contains more calories of food value than a gallon of average Friesian milk. On the other hand, the percentage variation in compositional quality of Jersey milk from one milking to another is greater than in the case of Shorthorn or Friesian milk.

Physiological Disturbances. It is now recognized that a number of cows which produce milk of low compositional quality are neither diseased nor insufficiently fed. Their milk may be well below the herd or breed average in composition, and may remain low from one lactation period to another.

In thinking over the various causes which are known to produce changes in the fat content of cows' milk, it occurred to us in 1931 that a rise in fat percentage frequently resulted when the *metabolic rate* of the cow was increased. Why not, therefore, find out whether small doses of thyroxine, the iodine-containing hormone of the thyroid gland which has the characteristic effect of increasing metabolic rate, would increase milk quality when given to a lactating cow ?

This experiment was first tried by feeding dried thyroid gland to lactating cows, and preliminary results were obtained showing a rise both in quality and quantity of milk. Eventually it was shown that if thyroxine were administered in small quantities daily to cows past the peak of lactation, both yield and quality of their milk were increased. There was in the milk more protein and lactose and milk fat, and less water. In some cows the daily yield of fat was increased by 40–50 per cent, so the results produced were not small. If, however, the thyroxine were administered before or at the peak of milk production, both milk volume and fat production were diminished.

Concomitant with the increase in milk quality, there was a rise in the speed of circulation of the blood, in the breathing-rate, and in the level of sugar in the arterial blood.

The improvement in milk quality *may* have been due to an increase in the blood sugar. It is known that the level of blood sugar decreases quite markedly whilst the blood is going through the udder, and there is some evidence that the larger the yield of milk, the more blood sugar is taken out of the same volume of the blood by the udder. It is an attractive hypothesis that the sugar-level in the blood reaching the mammary gland is one of the main factors in improving milk secretion. It is known that if the blood sugar is diminished, the amount of milk secreted in a given time is decreased, and also that the chemical quality of the milk produced is lowered.

Whatever the mode of action of thyroxine, there is no doubt of its potency in improving milk quality, and the question arises as to whether poor quality milk that cannot be ascribed to disease or faulty feeding of the cows is due to inherently poor thyroid secretion.

But the thyroid is not the only hormone concerned. It was found some ten years ago that an extract of the anterior portion of the pituitary gland will stimulate milk secretion in animals the mammary glands of which are fully developed but from which the ovaries have been removed. Later it was found that crude extracts of anterior pituitary gland would cause an increase in yield of milk and a slight rise in the percentage of fat in that milk if administered to normal cows in declining lactation. Purified extracts of this gland, containing very small amounts of solid matter, are also potent in this respect. The activity was at first ascribed to a single hormone of the pituitary which was called prolactin. Very recent work has gone to show that this activity is, in fact, due to the co-operation of two separate hormones of the anterior pituitary—prolactin and glycotropin. The whole story, in which the relationship of the pituitary hormones to thyroid gland stimulation is probably involved, is at present far from clear.

The matter is still further complicated by the discovery, made about four years ago, that a hormone of the ovary—œstrone—when administered to a cow in full lactation, causes a slight initial fall in milk yield, but a considerable increase in the proportion of non-fatty solids in the milk, an increase which may persist for weeks after the œstrone treatment has been discontinued and the initial slight fall in yield has worn off.

Though the general picture is only beginning to take shape, we now know of more than one glandular extract by the administration of which milk quality may be, in certain circumstances, improved. Other agents, some of them œstrogenic, as well as being relatively cheap and capable of chemical synthesis, are being tried, dosages and methods of administration compared, difficulties are being overcome, and in time methods of practical importance to the farmer in controlling and increasing udder efficiency will undoubtedly be evolved.

Adventitious Watering. The traditional association of the pump and the milk distributor is one of the three or four classical music-hall jokes. In fact, it is surprising how *little* water is put into milk, when one considers the difficulties of detection and the fact that milk is sold, under our present system, by volume and not by quality.

Methods for detecting added water have improved somewhat during the past few years. The ultimate criterion at present as to whether a given sample of milk is watered is by determination of the freezing-point of the milk. It will be remembered that the dissolving of even a small amount of salts or other small molecular solutes in water depresses the freezing-point below that of pure water to an extent which depends on the number of particles in a given volume of solution. It has been shown that fresh milk shows a practically constant depression of freezing-point (Δ) from one cow to another. If the milk is fresh, whether it is of low or high solids content, or comes from a cow which is healthy or diseased, it almost invariably has a Δ of between 0·530° C. and 0·555° C. Addition of water diminishes the Δ, that is, brings the freezing-point of the milk nearer to that of pure water, in proportion to the amount added, and it may be taken as certain that if the Δ of the mixed milk of a herd, or of a bottle even of pasteurized milk, is below 0·530° C., then water has got into it somehow. All we can then hope is that it is not dirty water.

Little or no variation is caused in this constant even by udder disease. While udder disease may cause a drop in total milk solids, and a rise in the proportion of water present, the diminution in the lactose and other characteristic milk constituents is osmotically balanced by an increase in the amount of sodium chloride, so that Δ remains the same. Pasteurization of the milk, or even boiling, has only a minute effect on Δ. If, however, the milk is kept for a while and bacterial growth sets in, the number of small molecules in the milk begins to increase and the Δ increases also.

(To be continued.)

GEOLOGY AND EARLY MAN

BY H. B. S. COOKE, PROF. C. VAN RIET LOWE AND L. H. WELLS,
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THE recent contribution by T. T. Paterson[1] under the above title provides a welcome stimulus towards the general reconsideration of Quaternary events throughout the world, and towards the ultimate unification of our rather scattered knowledge. So wide a survey must inevitably provoke that discussion which Paterson invites in his concluding sentence. His contribution provides an admirable foundation, and should lead, as it has in the case of the present writers, to joint observations by local workers in the various areas and fields concerned. To deal fully with the many points raised would require much space, and as we are most closely concerned with Africa, and particularly with southern Africa, this discussion deals mainly with points relevant to this region.

In such a discussion it is inevitable that most attention is devoted to those topics upon which we differ from Paterson, those upon which we are in agreement with him being largely passed over. It is, in particular, most welcome to find that appreciation is at last given to Geikie's great work, which, though at one time discarded, has now been found to have a sound foundation and a wide application to the northern glaciations. We agree equally with the adoption of Haug's faunal definition of the base of the Pleistocene. Paterson's brief appraisal of the succession of Pleistocene faunal assemblages is also acceptable, and will probably prove to hold good broadly for Africa as well as for other parts of the world.

The geological correlations put forward by Paterson are of a controversial nature, but while the author's studies in India and elsewhere entitle his opinions to the most serious consideration, it would appear in general that the available evidence is inadequate for the conclusions outlined. Correlations within almost every region considered are still very uncertain. The glacial phenomena observed by Lee[2] in China still await detailed work and correlation with the sedimentary cycles; in the same country De Chardin and others are not yet decided upon the course of events; in India, Morris[3] has only recently brought forward evidence illustrative of the difficulties of *cis*-Indus and *trans*-Indus correlation; in northern Africa and in East Africa the sequence is only provisionally outlined, and in southern Africa there is as yet no evidence justifying correlation with other areas.

In the correlation given for the Vaal River Basin, the three phases of the Younger Gravels are indicated as spread over a period ranging from the bottom of the Middle to the lower division of the Upper Pleistocene, while the Older Gravels are placed in the upper portion of the Lower Pleistocene. It must be pointed out that the Older Gravels lie in terraces at elevations from 50 to 300 feet above the present river-level, whereas the Younger Gravels form a closely linked group at levels up to about 40 feet above the river. There is little doubt that the time occupied in the formation of the Older Gravels must have been considerable, and there is also evidence that a long interval separated their deposition from that of the Younger Gravels. The formation of the Younger Gravels cannot have occupied a comparable length of time, and the intervals between the three phases must have been geologically short.

I have recently been attempting to correlate the Quaternary geological events in southern Africa, and though many difficulties lie in the way of effecting correlations even in so small a region, it appears probable from geological and faunal evidence that the Younger Gravels are of Upper Middle Pleistocene age. The Older Gravels are provisionally referred to the Lower Pleistocene, though it is not impossible that they might even range in part into the Pliocene. As a result of this recent work I have also concluded that the grounds for correlation between southern and east Africa rest at present on too insecure a basis to be of much value. This does not, of course, imply that Paterson's correlations may not be largely applicable elsewhere where the evidence is perhaps more adequate, but at present the sequence in the Vaal River Basin cannot reasonably be interpreted in the manner suggested in that correlation.

There is now accumulating a considerable body of evidence to show that world-wide climatic changes occurred during the Pleistocene, and Paterson's observations on the possible cause of the Ice Age are extremely interesting. Daly had already largely established the simultaneity of glacial phenomena in the northern and southern hemispheres, and now Nilsson's[4] work in East Africa and Abyssinia shows almost conclusively that the Pleistocene climatic changes effected a reduction in the width of the equatorial belt and not the southerly shift advocated by Penck and others. Nilsson has also shown the apparent coincidence of glacial advance and "pluvial periods", which provides strong support for the theory that increased precipitation is accompanied by glacial advance. The theory advanced by Paterson would appear to fit in with these conditions and is thus of the greatest interest. Simpson's theory, however, which Paterson regards as the most acceptable, requires the production of two glacials corresponding to one major cycle of precipitation and consequently to only a single "pluvial" episode. On p. 14 of his account, Paterson remarks that the "major periods of aggradation follow on those erosional periods coincident with glacial advance" and this would not be true if a single "pluvial" represented two periods of glaciation. At present, therefore, the precise correspondence between glacials and "pluvials" cannot be regarded as established, and the basis for part of Paterson's correlations is thus very insecure. The effect of the Pleistocene climatic changes is very different in different regions, and the changes in precipitation in southern Africa appear to have been of a sufficiently low order to be readily masked by superimposed local phenomena. There is, nevertheless, a great deal of evidence in the northern hemisphere to encourage the correlation of glacial and periglacial phenomena there, and it should not be long before the extra-glacial regions can be fitted in with some degree of confidence. It is nevertheless felt that the geological correlation must be the foundation of comparison between scattered regions, and that this foundation cannot be established with sufficient confidence in the light of the present evidence. H. B. S. C.

In his contribution "Studies on the Ice Age in India and Associated Human Cultures" published last year[5], Paterson concluded his chapter on the prehistory of the Potwar and Indus regions with the statement that "further work is being carried out on new finds from the Punjab and the Madras palæolithic industries. Until this work is completed, it would be useless to attempt correlations or comparisons between northern and southern India". Following as this did on an unusually valuable description of the finds from eleven recently discovered palæolithic stations spread over an area of about 10,000 square miles in the basin or vicinity of the Soan River, one emerged from this first comprehensive contribution on the recent geology and prehistory of northern India with great hopes for the future of research in this field.

The outstanding contribution to our archæological knowledge was a detailed description of the Soan Culture originally noted by De Terra[6]. This new culture embodies a progressive series of pebble-and-flake industries spread over a long stratigraphic range. Comparisons could not reasonably be drawn between it (or any phase of it) and pebble, flake, or pebble-and-flake industries in other parts of the world. Yet within a year Paterson has attempted correlations and made comparisons not only between occurrences in northern and southern India but also between occurrences (both geological and archæological) in China, Java, north, central and southern Africa, Germany, France and North America, laying particular stress on the Soan Culture.

This culture is apparently based on eleven sites which yielded (*a*) pebble artefacts in certain cases, (*b*) pebble and Clacton-type flakes in some, and (*c*) pebble and Levallois-type cores and flakes in others—the whole representing five progressive divisions of the main culture. Only one "impure" site was found, namely, Chauntra. This yielded Soan tools together with elements of the hand-axe culture (? Abbevillian and Acheulean). He goes so far in his new paper as to assign the culture to a "genus" of the Clacton "family" and in it he recognizes half a dozen "species": the Kafuan-Oldowan of East and Central Africa, the pre-Stellenbosch and Stellenbosch I of South Africa, the Anyathian of Burma as well as certain industries discovered by Collins in Malaya, and others by von Koeningswald in Java.

While I wholeheartedly agree that the Lower Palæolithic nomenclature is rapidly approaching a state of complete chaos and that far too many prehistorians and Pleistocene geologists have made excessive and unwarranted use of certain French and Alpine terms, I do feel that in spite of ingenious three-dimensional charts, he has over-emphasized the Soan in relation to other known material cultures. He has built up his argument on far too few facts and has done little, if anything, to ease our present difficulties. The Soan is something new, as the Stellenbosch was new a few decades ago. We know far too little about it. Eleven sites are not enough—more especially when we recall the many thousands of palæolithic home and factory sites that have yielded pebble artefacts of Soan form in Africa alone. It is suggested that the time has not yet arrived when on such slender evidence we can emphasize and interpret this new culture in terms of occurrences at Clacton-on-Sea, on the Kafu in Uganda and along the Vaal in South Africa.

From my own experience in the field and museums of north, central, east and southern Africa, I can definitely say that the descriptions we have of the Soan do not justify our accepting Paterson's views of its importance in the Kafuan, Oldowan, pre-Stellenbosch and Stellenbosch I cultures of Africa. These pebble or core and core-cum-flake cultures certainly include some Early Soan *forms*, but so far as I am aware not one of them includes such significant cores as the distinctly Levallois types that occur in the Early Soan C, for example. We have flake artefacts in Kafuan, Oldowan, pre- and early Stellenbosch assemblages that recall or resemble certain Clacton forms, but none of them yet found is so advanced or sophisticated as the Early Soan specimens illustrated by Paterson. Despite the obvious mastery over the *bloc-en-bloc* anvil technique exhibited by Stone Age man during the Lower Palæolithic in Africa, we are not justified in correlating the cultures that include Clacton-like flakes in Africa with similar occurrences in Europe or India at this stage; or if we are, there would appear to me to be no reason why we should not rather emphasize the more fully described core-cum-flake Stellenbosch of the Cape. For years, for example, I have known the core-cum-flake biface (hand-axe and cleaver) industries of the Madras area to be mirror images of the Upper Stellenbosch of the Cape, which in turn is almost perfectly represented in the Upper African Acheulean of east-central Africa. I have often felt that if at this stage these Madras occurrences are to be given a name other than the helpful but rather loose southern Indian Acheulean, that name should be Indian Stellenbosch, but I have never felt justified in urging my point. Yet the evidence we have for such a comparison is based on much more substantial and widespread discoveries and data (geological and typological) than we have in the case of the comparisons Paterson has drawn.

I cannot escape the conviction that, on the evidence before us, Paterson's interpretations are premature and over-bold. Nevertheless I welcome his contribution, and sincerely trust that the discussions which are bound to follow will bring us a step nearer the solution of the most difficult problem that confronts the prehistorian of the present: the problem of comparison and correlation and the consequent need for a set of terms of wider application than those at present in use. Perhaps I should add that I have for a long time felt that prehistorians cannot hope to solve this major problem until Pleistocene geologists have reached an acceptable agreement on climatic correlations. Once we are able to correlate climatic events in India with climatic events in Africa or Europe or elsewhere, we can compare (1) the remains of human industry recovered from deposits related to these events, and (2) the products of human industry on the bases of typology and underlying processes.

In this way and in this way only, shall we learn whether the Soan of the Punjab is or is not older than the Clacton or Kafuan or pre-Stellenbosch, and so establish the genealogical and generic relationships that may exist between the products of human industry *where we have a sufficiently representative series of products* and allow for missing elements on worked sites. The much-needed new terminology will then emerge naturally. Until this fortunate state of affairs is reached I feel that so far as the Lower Palæolithic cultures are concerned it is better to struggle on (as we perforce must in the Upper Palæolithic) with such *local* terms as Clacton, Kafuan, Oldowan, Soan, etc., and where we can do so on such typological grounds as we have in the great hand-axe cultures, continue the more widespread yet tentative use of such established terms as Abbevillian and Acheulean, prefixing them where necessary with the words "African" or "Indian" as the case may be. In other words, let us for the moment recognize the Soan as something essentially north Indian, and limit the use of the term to India. C. v. R. L.

In the concluding section of his article Paterson treats of "The Development of Pleistocene Man". Herein he advances the conception of a subdivision of human types into three main stocks, Hominoid (Neanthropic), Palæanthropoid (Neanderthaloid) and Pithecanthropoid (including Sinanthropus). Each of these stocks, which it is considered should be given generic status, is supposed to be associated with a particular stream of development of Palæolithic culture. Moreover, as Paterson argues for the formation of mixed cultural groups by the fusion of these fundamental streams, so he presumes a corresponding mixture of the fundamental physical stocks to produce hybrid types.

There is undoubtedly much that is attractive in these views. Unfortunately, in their construction there seems to be insufficient differentiation between established facts and as yet unproved hypotheses. This is glaringly displayed in the opening sentence: "It is *already well established* (italics mine) "that Palæanthropoid man is associated with 'Levallois' culture, and '*Homo sapiens*', as distinct from '*Palæanthropus*' with the Acheul". While the first half of this statement may be substantiated, the second is supported by only the most tenuous evidence. Indeed, the only human fossil which is associated beyond doubt with the "Acheul" hand-axe culture is the Swanscombe skull, and the sapient or even proto-sapient character of this specimen cannot be regarded as proved, in view of the conclusion of the Swanscombe Committee[7]: ". . . it is necessary to admit that the missing parts of the Swanscombe skull may have been so formed as to provide clear evidence of differentiation from modern man." Paterson indeed assigns to his "Hominoid" stock the Piltdown skull, which is neither definitely associated with the great hand-axe culture nor indubitably proto-sapient in character, as well as a number of other specimens of debatable antiquity and associations.

Of these ascriptions the most provoking, to an African anthropologist, is the Kanjera material, the Acheulean associations of which Paterson is prepared to admit in spite of the objections of Boswell. This view may well be correct, although the history of the Olduvai skeleton urges caution. It brings in its train, however, a complication not hinted at by Paterson. Sir Arthur Keith[8] has described the Kanjera remains as "already endowed with features which definitely assign them to the African or Negro stock"; this judgment has been elaborated by Galloway[9], who has demonstrated in detail the affinities between the Kanjera remains and those from Boskop and elsewhere in South Africa. These remains, then, are not "Basic Mediterranean", as implied by Paterson, but in a broad sense "Negroid".

The "Negroid" type Paterson has proposed to derive from a fusion, as early as the middle Pleistocene, of "Hominoid" types practising a hand-axe culture with the "Pithecanthropoid" practitioners of a "Soan" culture. To this hybrid group he assigns Rhodesian man, remarking, at the same time, upon the resemblance of this type to *Homo soloensis*, which is conceived as the continuation of the unmodified Pithecanthropoid stock. Certainly, as has been repeatedly observed, Rhodesian man presents definite affinities to Pithecanthropus and Sinanthropus, as well as to the "Australoid" types of modern man. These indications are elucidated by material which Paterson has not considered, his only other reference to an African fossil type being to "*Africanthropus*" *njarasensis* of Weinert, which is in fact much too fragmentary for serious argument.

Paterson's most notable omission is the Florisbad skull, which is crucial in any interpretation of African types of man. Drennan[10], who in contrast to other South African investigators regards this skull as essentially Palæanthropoid in nature, nevertheless observes that "in Florisbad man, Rhodesian man, and the Cape Flats australoid skull we have a closely related phylogenetic sequence from Southern Africa linking the *Homo primigenius* to the *Homo sapiens* type". Dreyer[11] and Galloway[12], with Sir Arthur Keith[13], have considered the Florisbad skull to be at least proto-sapient and the precursor of later African types. This conception has been developed most elaborately by Galloway, who has shown that the Florisbad type links together the Rhodesian, Wadjak-Australian, and Boskop types. The last-named is clearly intimately related to the Bush-Hottentot group, and probably also to the true Negro, the Asselar skull described by Boule and Vallois forming a possible link between the Boskop type and the Negro. Thus Galloway has envisaged a scheme of relationships for the African and "Australoid" types not far different from that propounded by Paterson. It differs, however, in deriving this type not from a hybrid Hominoid-Pithecanthropoid ancestry, but from a single proto-sapient stock which could equally be the ancestor of the "Basic Mediterranean" and the rest of the sapient types.

Paterson's thesis is in fact an expression of the current tendency to an exaggerated polyphyletic conception of human evolution, though distinguished by his meritorious insistence on the possibility of hybridization as well as of independent evolution. It appears desirable to restate the simpler conception of Sinanthropus (whatever may be the relation of this type to Pithecanthropus) as a generalized as well as primitive human type which may well have given rise to both the Palæanthropic and Neanthropic stocks. Whether the differentiation of these stocks took place at the Sinanthropus level or, as is suggested by the Steinheim skull, not until a more advanced stage in development had been reached, is of minor importance. At every stage there must have been a great deal of variation around the periphery of every group. The scheme of relationships proposed by Dart[14] may with advantage be considered in this connexion.

The attempt to combine the discordant interests of polyphyly and hybridization with a formally binomial taxonomy raises in an acute form the problem of the zoological status and nomenclature of human types. Broom[15] has trenchantly criticized the arguments of Zuckerman on this question. Paterson's view, however, formally involves the hybridization of three genera belonging to two sub-families in order to give rise ultimately to a single species. Although the production of fertile offspring is no longer regarded as proof of specific identity, this is not altogether easy to visualize. Whether the problem needs to be solved by the drastic revision of our terminology advocated by Zuckerman remains to be seen. There is undoubtedly much to be said for Paterson's argument that man should be considered as a domesticated animal from this point of view, but the implications of this view demand careful examination.

In concluding this necessarily brief account, I wish to repeat on behalf of my co-workers and myself that our pre-occupation with those aspects of Paterson's comprehensive review which have struck us as particularly debatable does not imply any lack of appreciation of the value of his work as a whole. To have enumerated all the many topics upon which our views agree entirely with his has seemed unnecessary, and we feel that he is especially to be congratulated on his courage in advancing for discussion a thesis which another worker might have pondered but not ventured to publish. L. H. W.

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BY T. T. PATERSON,

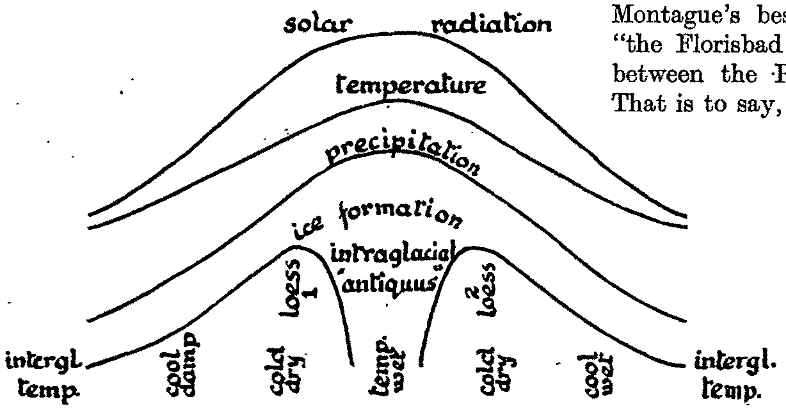
UNIVERSITY MUSEUM OF ARCHÆOLOGY AND ETHNOLOGY, CAMBRIDGE

These criticisms are welcome and helpful. In drawing up my Pleistocene correlation I first rejected the idea of glacial-pluvial correlation and began afresh constructing series of sedimentary cycles in tabular form. In areas where the sequence is complete seven cycles are present; in others some are missing, always the earlier. By comparing these tables with the three standards I adopted, those for Europe and India which I know well, and for China (I was assisted in this by Père Teilhard de Chardin), the correlation became obvious.

The Older Gravels of the Vaal River Basin may extend much farther back than phase I_2 but not later. The "long interval" referred to by Cooke, separating them from the Younger Gravels series, is reckoned on erosion depth and so surely depends on the intensity of erosion. A similar "long interval" of this age exists in almost every region. It is one of the stronger supports of my correlation. Moreover, if the faunal evidence suggests that the Younger Gravels are of "Upper Middle Pleistocene age", that is, I presume, on the faunal chronology of Hopwood, then there is nothing in this contrary to my proposition. I am unaware of the existence of a good fauna in the Vaal Basin.

In Simpson's theory the important point is his contention that *increase* in solar radiation produces glaciation; not decrease according to Croll's theory. But my application of Simpson's theory to the correlation which I found to occur, aguing to, not from the thesis of glacial-pluvial correlation, is a modified form of the theory. The curves here illustrate that modification. Thus in glacial and periglacial regions one cycle of solar radiation fluctuation produces two glacial pulsations during each glaciation and two terrace forms, while in non-glacial regions there is only one pluvial period and one terrace escarpment. Therefore, there must have been five major solar radiation cycles, reaching a maximum for the second glaciation and decreasing continuously thereafter.

Prof. van Riet Lowe's criticism deals essentially with nomenclature, though apparently he mistakenly believes that I think the Palæolithic exists in North America. "Further work," including another expedition to India by my colleague H. J. H. Drummond, revealed the Soan widespread in southern India. There are now more than thirty good sites known to us in the vast area that is India. The Soan technical tradition as I now see it extends from phase m_1 to u_3, from simple pebble tools + flakes, to pebbles + simple cores and flakes (Breckland types), to pebbles + cores and flakes (Moustierian types). Stellenbosch is a compound name indicating the presence, in South Africa, of two traditions, biface and core-flake-pebble (choppers) conjoined. If one or other of these traditions can be found separately over a long period then each deserves a tradition name, namely, Acheul and Soan. In South India, what I term Soan Acheul, or Acheulian Soan, could quite well be compounded into Stellenbosch and mean the same. If now in the earliest stages of the South African sequence, pre- and Stellenbosch I, only *one* tradition is found then a compound name cannot be applied, but only the single tradition name, and if these stages are core-flake-pebble comparable to the *earliest* stages of the Soan tradition, of the same age, then the latter name is justifiable. The Kafuan-Oldawan is more "pebbly" than the type Soan but within the range of variability of that technical tradition.



CLIMATIC CHANGES IN THE PERIGLACIAL REGION

If, as I believe I have demonstrated, the remains of human industry can be correlated geologically, then the attempt I make at determining the "genealogical and generic relationships" is profitable though it may not by any means be final. The "few facts" to which Prof. van Riet Lowe refers amount to several tons of rock in the Cambridge Museum.

The association, which I "glaringly" state, of proto-sapient and sapient forms with Acheul is based on my own practical experience of the conditions under which four crania have been found. The Swanscombe fragment, phase m_2, is one. Dr. Wells doubts whether I am justified in using this "unproved" evidence of sapient type, but on the other hand a very eminent authority has written castigating me for suggesting that Swanscombe man is anything but *Homo sapiens.* In the case of Piltdown man, depending upon the attitude of each individual researcher, it can be, or cannot be, regarded as proto-sapient; we have but to remember the controversy between Sir Arthur Smith Woodward and Sir Grafton Elliot Smith. For its geological horizon I follow Clement Reid, though I am well aware of Hopwood's opinion, and there is my own knowledge of extensive Lower Acheul occurrences within the gravels of the same age throughout southern England almost to the complete exclusion of others. The Bury St. Edmunds fragment, phase u_2, indubitably sapient, comes from a loam out of which Upper Acheul artifacts have been recovered. There are several sites around the same area where a similar loam yields a complete Upper Acheul industry. The Acheulian association of the Kanjera skull I am well prepared to admit, for I had the good fortune to be with Leakey in East Africa at the time of the controversy regarding this matter.

It is certainly reprehensible that I omitted Galloway's thesis on the relations of the Florisbad skull, but equally reprehensible is it that I did not mention Keith's ideas, Weidenreich's and Ashley-Montague's besides others. Quoting Galloway[1], "the Florisbad type [is] somewhere intermediate between the Rhodesian type and later types". That is to say, Rhodesian man is ancestral to the Negroid. The proto-sapient features of *rhodesiensis* are well enough known and Galloway goes on to say[3], after pointing out the close relationships of the Boskop type, *wadjakensis* and the Australoid, that the "Eyassi and Sinanthropus itself may well be variants of an early generalized type of which Rhodesian Man and Solo Man represent their respective modern recent descendants." The close generic relations of *soloensis* and *wadjakensis* are striking enough, hence these remarks support my proposition. The Florisbad type and *wadjakensis* are but derivatives of the hominoid-pithecanthropoid hybridism, the former towards the Negroid end, and the latter towards the Australoid end of the range of variability. I cannot deny, and make no pretence of doing so, that as a result of heterozygosis, and consequently greater variability within the proto-sapient stock, Kanjera may show Negroid affinities yet remain proto-sapient.

It is obvious that I am driving the hybrid horse rather hard, and this brings up Dr. Wells's last criticism regarding nomenclature. As Holmes[3] says, "few species of organisms present so great a variety of hereditarily diverse strains as our own". Hooton discovered a very fine specimen of a neanderthaloid "all-in wrestler" the other day in Boston, and it seems that the neanderthal type comes within the wide range of variability of the species *Homo sapiens.* I should hesitate long before suggesting that the pithecanthropoid is also a variety of the same species, but within the next order of difference it can be regarded as a different species of the same genus. That is to say, all those forms I discussed are species and varieties of the genus Homo. I can see, therefore, no objection to postulating hybridism, but like Zuckerman, I believe something must be done about nomenclature. To give an absolute classification, while regarding man as a domesticated animal, is not feasible, for then the wide variation of hominoid forms would demand for its setting out something like the Highland and Agricultural Society's Pedigree Book. I separate out these stocks as "genera", as I have indicated, because there is evidence outside the anatomy to support this first subdivision. Essentially they should be regarded as having at the most no more than specific differences. If I had suggested specific names then the classification of hybrid offspring of these stocks would have been as varieties at least, and the whole system would have become exceedingly clumsy.

I am grateful to Prof. D. A. E. Garrod for pointing out to me that Skhul man is not found with a hybrid culture.

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[1] Reference 12, p. 12.

[2] *ibid.*, p. 14.

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OBITUARIES

Prof. H. J. Spooner

WE regret to record the death of Prof. Henry John Spooner, former head of the School of Engineering at the Polytechnic, Regent Street, London, on December 16, at the age of eighty-four. Born on June 16, 1856, he received his training at the Royal School of Mines, and was first associated with the Polytechnic in 1882, when the first series of lectures on engineering subjects was given by him. He was appointed head of the School of Engineering on its formation in 1886, a post which he held until his retirement in 1922.

He also practised as a consulting engineer, and took out a number of patents dealing with steam and internal combustion engines. He was one of the pioneer motorists, took a great interest in the early development of the aeroplane, was a great advocate of the elimination of noise, and was also intimately connected with the development of time-motion studies, for the purpose of improving the efficiency of various operations. He was also the author of a number of engineering text-books, and many thousands of students passed through his hands.

During the War of 1914–18, large numbers of workers of both sexes underwent intensive courses of instruction under his supervision, and he was also honorary technical adviser to the King George Hospital and to the Union of South Africa in connexion with vocational training at the military hospital in Richmond Park.

He was a member of the Institution of Mechanical Engineers, an associate member of the Institution of Civil Engineers, a member of the Institution of Automobile Engineers, and a fellow of the Geological Society, in addition to several other engineering and scientific bodies. In 1895 he became a Knight Commander of the Royal Order of St. Sava, Serbia, and in 1907 he became a knight of the Golden Cross of the Redeemer, Greece. P. KEMP.

Prof. M. Askanazy

PROF. MAX ASKANAZY, a leading Swiss pathologist, whose death has recently been announced (*Schweiz. med. Doct.*, 70, 1072; 1940), was born at Stallupönen in East Prussia on February 24, 1865. He studied medicine at Königsberg, where he qualified in 1890, and from then until 1895 served as assistant in the Pathological Institute. In 1894 he became lecturer in general pathology, pathological mycology and morbid anatomy, obtaining the title of professor in 1903. Two years later he was appointed professor of general pathology at Geneva. The high esteem in which he was held by his pupils and friends was shown on the occasion of his sixtieth birthday in 1925, when they dedicated to him a *Festschrift* which formed part of the 254th volume of *Virchow's Archiv*. His investigations occupied a wide field, but he devoted himself mainly to a study of the hæmopoietic system, animal parasites, and experimental and spontaneous tumours in man. His chief publications were "Dermoid Cysts of the Ovary" (1905), "Bone-marrow" (1927), and "Inflammation" (1929).

The honours conferred upon him included the Marcel-Benoist Prize in 1936, the freedom of the city of Geneva, and the honorary doctorate of the Universities of Coimbra and Geneva.

He died shortly after his seventy-fifth birthday.

J. D. ROLLESTON.

WE regret to announce the following deaths:

M. Henri Bergson, the celebrated French philosopher, on January 6, aged eighty-two (see also NATURE of January 4, p. 24).

Prof. Raymond Pearl, professor of biology in the School of Hygiene and Public Health, Johns Hopkins University, aged sixty.

Major L. C. D. Ryder, a member of the British Graham Land Expedition, 1935–37, reported killed in action, aged thirty-nine.

NEWS AND VIEWS

Major-General Iven Mackay, C.M.G.

THE mantle of General Monash, the Australian civil engineer who proved to be the greatest military leader of the Australian Imperial Forces during the War of 1914–18, has fallen on another man of science, Major-General Iven Mackay, who is in command of the A.I.F. now operating in Libya which recently took a leading part in the successful attack on Bardia. Mackay was assistant lecturer and demonstrator in physics in the University of Sydney in 1910, where he had obtained his 'blue' for rowing and for football; he combined his aptitude for sport with his scientific training by acting as sports as well as science master in the Sydney Church of England Grammar School during 1905–10. When he joined the staff of the Physics Department of the University of Sydney he also became a sports coach. Later he undertook the duties of student adviser. He worked in the Cavendish Laboratory during 1919. In 1933, he became head master of Cranbrook School, Sydney, and held that position until 1940. During his early career at the University thirty-six years ago he, together with several others, organized the Sydney University Scouts, which eventually formed the nucleus of the New South Wales sector of the A.I.F. Mackay was born on April 7, 1882, the son of a Scottish father and a Canadian mother.

New Year Honours List

THE names of the following scientific men and others associated with scientific work appear in the New Year Honours List: *O.M.:* Prof. Gilbert Murray, F.B.A., trustee of the British Museum and president of the International Committee for Intellectual Co-operation. *Baronets:* Sir Kenneth Lee, lately director general and secretary of the Ministry of Information, formerly chairman of the Industrial Grants Committee of the Department of Scientific and Industrial Research; Mr. Hugh Lett, president of the Royal College of Surgeons. *K.C.B.:* Dr. E. V. Appleton, F.R.S., secretary of the Department of Scientific and Industrial Research. *K.B.E.:* Mr. D. E. Vandepeer, second secretary, Ministry of Agriculture and Fisheries. *Knights Bachelor:* Khan Bahadur Maulvi Azizul Haque, Vice-Chancellor, University of Calcutta; Dr. S. S. Bhatnagar, director of industrial development, Advisory Board of Scientific and Industrial Research, and lately director of the University Chemical Laboratories, Lahore; Prof. W. L. Bragg, F.R.S., Cavendish professor of experimental physics in the University of Cambridge (who is taking the style Sir Lawrence Bragg); Brevet Colonel R. N. Chopra, professor of pharmacology and director of the School of Tropical Medicine, Calcutta; Mr. R. B. Ewbank, lately Commissioner for Natural Resources, Newfoundland; Dr. James Weir French, chairman of Messrs. Barr and Stroud, Ltd.; Mr. P. R. Laird, secretary, Department of Agriculture for Scotland; Brigadier C. G. Lewis, surveyor-general of India; Prof. J. S. E. Townsend, F.R.S., Wykeham professor of physics in the University of Oxford; Prof. R. S. Wallace, Vice-Chancellor, University of Sydney.

C.B.: Mr. J. S. Pringle, director of electrical engineering, Admiralty; Mr. R. A. Watson Watt, scientific adviser on telecommunications, Ministry of Aircraft Production. *C.M.G.:* Mr. C. Bullock, secretary for native affairs, chief native commissioner and director of native development, S. Rhodesia; Prof. R. T. Leiper, F.R.S., professor of helminthology in the University of London and a director of the Department of Parasitology, London School of Hygiene and Tropical Medicine; Mr. J. R. Mackie, director of agriculture, Nigeria. *C.I.E.:* Prof. H. G. Champion, professor of forestry in the University of Oxford, lately conservator of forests, United Provinces; Mr. C. G. M. Mackarness, conservator of forests, Assam; Lieut.-Colonel H. E. Short, director of the King Institute, Guindy, Madras; Mr. C. C. Wilson, chief conservator of forests (retired), Madras. *C.B.E.:* Mr. G. E. Bailey, managing director of Messrs. Metropolitan-Vickers Electrical Company, Ltd.; Mr. R. T. G. French, secretary of the Electricity Commission; Mr. G. Hogarth, fisheries secretary, Scottish Home Department; Lieut.-Colonel C. A. MacLean, cane commissioner, Bihar; Mr. W. E. Nicholson, director of education, Sierra Leone.

O.B.E.: Sukumar Basu, secretary of the Imperial Council of Agricultural Research; Mr. R. S. Browne, deputy conservator of forests, Madras; Major D. R. Crone, superintendent of the Survey of India; Mr. R. M. Drake, secretary of the Association of British Chemical Manufacturers; Mr. J. R. Haddow, veterinary research officer-in-charge of serology, Izatnagar; Mr. A. G. Herbert, secretary of the Forestry Commission; Mr. C. Hollyoak, superintendent of the Royal Ordnance Factory, Not[illegible]ngham; Mr. F. G. L. Holland, director of [illegible], Gilbert and Ellice Islands Colony; Dr[illegible]ck, director of agriculture, Fiji; Dr. [illegible]ns, marine superintendent of the Lan[illegible]estern Sea Fisheries Committee; Mr. [illegible]th, principal of the Presidency Coll[illegible]r. G. F. Masters, superintendent o[illegible]d Carriage Factory, Royal Ordnance [illegible]ch; Mr. J. W. Mills, deputy director [illegible]uction, Ministry of Aircraft Pro[illegible]ytton, chief livestock office[illegible]re and Fisheries; Mr. J. Ta[illegible] Ministry of Agriculture, [illegible]: Prof. Ananta Prashad [illegible] professor [illegible] Sanskrit, Patna College, [illegible] A. J. Noronha, lecturer in bacteriology [illegible]ology, B. J. Medical School, Poona, Bombay [illegible]f. Cumbakonam Kailasa Krishnaswami Pillai, professor of geology, Presidency College, Madras; Tufail Muhammad Chhaju Khan

Rajput, criminal tribes settlement officer and personal assistant to the collector of Sukkur, Sind; Raj Narain Singh, deputy conservator of forests, Utilization Division, Naini Tal, United Provinces; Dr. Raghunath Sabajirao Tiradkar, professor of medicine, Grant Medical College, and honorary physician, J. J. Hospital, Bombay.

Prof. A. F. Joffe: Award of Order of Lenin

FOR his outstanding work in physics, Prof. A. F. Joffe has been awarded the Order of Lenin, the highest honour in the Soviet Union. The award was made on the occasion of Prof. Joffe's sixtieth birthday. Prof. Joffe's study of the mechanical and electrical properties of crystals has gained him a world-wide reputation. His work on the photoelectric effect and the magnetic field of projectiles is of importance; during the past few years he has investigated semi-conductors. Under the guidance of Prof. Joffe, experiments have been carried out as a result of which it has been possible to increase the frost-resistance of Soviet-grown caoutchouc and to work out a new method for the manufacture of plastic synthetic rubber. He was responsible for the establishment of the Physico-Technical Institute in Leningrad in 1918, the first of a system of physico-technical and physico-chemical institutes in the Soviet Union in Kharkov, Dniepropetrovsk, Sverdlovsk, Tomsk, and elsewhere. Prof. Joffe is a member of the Academy of Sciences of the U.S.S.R. and also of many scientific academies of other countries.

Air Raid Damage at the Royal Observatory, Greenwich

THOUGH parts of the Royal Observatory, Greenwich, have been damaged on several occasions during recent air raids, the historic Wren building of 1675 remains substantially undamaged and the damage to instrumental equipment has been of a minor nature. The south portico of the Altazimuth pavilion was hit by a high explosive bomb and partly demolished. The Altazimuth instrument had recently been dismantled and a small reversible transit instrument mounted in its place; this was thrown from its mounting and broken in two, but the object glass and impersonal micrometer were undamaged. A personal equation machine had been fitted to the collimator in the south portico; this and the collimator-objective sustained no damage. Though the main gates were destroyed, the Shepherd 24-hour electric clock, well known to visitors to the Observatory, received only slight damage. The damage to the coverings of the domes has been considerable, but the objectives and mirrors of the principal telescopes, with other valuable equipment, were dismounted and sent away for safety in the early days of the war. The main building, erected at the end of the last century, has received minor damage. The time service provided by the Observatory has been maintained without interruption; alternative arrangements had been made early in the War to ensure its continuance in the event of damage to the Observatory.

Air Raid Damage at the University of Liverpool

THE buildings of the University of Liverpool have been damaged during air raids. One of the chemical departments in the main University buildings received a direct hit, and extensive damage was done in the laboratory, generating and battery rooms: damage to the structure of the building, however, was superficial. Nevertheless, the building was severely rocked and many of the laboratory instruments were affected; the building was not in use at the time and there were no casualties. More than a hundred windows in the University buildings, and particularly the Engineering Laboratories, have been destroyed by blast. Bombs have also fallen in the grounds of both of the University's halls of residence; the damage, however, was slight, consisting mainly of shattered windows.

A Committee on Reconstruction

IT is announced that the Minister without Portfolio, Mr. Arthur Greenwood, has undertaken responsibility for the study of reconstruction and post-war problems. Later on, when the end of the War can be more clearly foreseen, a Ministry will be formed for this purpose. Meanwhile, Mr. Arthur Greenwood will be chairman of a group of Ministers studying these problems. The object will be to find practical solutions for the immediate problems of a transition from war to peace, and also to outline and presently to amplify a policy for the years immediately following the War which will command the support of the nation as a whole and enable united action to proceed in peace as in war.

Medical Planning Commission

A MEDICAL Planning Commission has been set up by the British Medical Association "to study war-time developments and their effects on the country's medical services, both present and future". It will consist of 68 doctors, representing all branches of the profession, under the presidency of Colonel Thomas Fraser, consulting physician to the Aberdeen Royal Infirmary. The detailed work of the Commission will be undertaken in committees and sub-committees. The chairman of the council will be Mr. H. S. Souttar, surgeon to the London Hospital.

The Universities: An American Tribute

YALE and Harvard Universities have sent a telegram to the Universities of Oxford and Cambridge conveying a tribute to the "dynamic courage of Great Britain" and stating that an important aspect of that courage is expressed "in the determination of your scholars to pursue their researches in the spirit of Milton's Seraph, 'Unshaken, unseduced, unterrified'". The Vice-Chancellors of Oxford and Cambridge have replied, sending "grateful acknowledgments to Harvard and Yale for their tribute to the resolution of this country". They go on to say: "The cause of liberty and learning, now eclipsed over most of Europe, is nowhere better understood than in the great and historic institutions from which these Christmas greetings come. The more profoundly do we appreciate their noble and moving recognition of our endeavour, together with the other Universities of Great Britain, to maintain the continuity of scholarship and to keep, even in these days, the standards of knowledge unimpaired and the sources of truth unsoiled."

University of London Certificate in Natural History

JUST before the outbreak of war, the University of London, in response to an expressed demand, instituted a Certificate of Proficiency in Natural History, designed for teachers who require an additional qualification testifying that they have a practical working knowledge of natural history such as will be of special value in teaching it to children up to the age of fifteen. The necessary studies involved attendance at a course of lectures and laboratory work of about three hundred hours' duration, together with a certain amount of organized field-work. Considerable interest was shown in the University's new departure, and some education authorities were prepared to arrange suitable courses: but the dislocation of the school teaching services all over the country has brought about the result that the courses of study contemplated by the University are not suited to the present-day circumstances of teachers.

Consideration has therefore been given to the possibility of devising some special emergency regulations which would meet the intention of the original requirements and make the best use of the fact that large numbers of urban schools are now located in the country or at the seaside, and so presented with an opportunity of natural history study in the field which, under normal peace-time conditions, would have been impossible; as a result emergency regulations have been drafted. The main principles of the proposed new regulations are: (*a*) to substitute for the present lecture-laboratory requirement a directed course of private reading together with attendance at a fortnight's summer vacation course arranged by the University, and (*b*) to take advantage of the teacher's probable extended period of residence in rural conditions by putting the main emphasis on the work in the field, involving the writing under expert advice of a substantial essay on some specialized topic chosen by the student. At the moment, however, the University has no evidence as to how far such a scheme would be welcomed by those teachers who might have been expected under normal conditions to have studied for the original Certificate. Any teacher, therefore, who is interested in the proposed new scheme as outlined is invited to communicate with the University Extension Registrar, University of London, at Royal Holloway College, Englefield Green, Surrey.

A War-Time Formulary

IN view of the urgent need for a comprehensive war-time formulary for the guidance of medical prescribers, it is satisfactory to learn that, at the instigation of the Ministry of Health, a strong and representative committee has been set up for the purpose of providing such a formulary for use during the emergency. The following bodies have been invited to appoint representatives: the Royal College of Physicians, the Pharmacopœia Commission, the British Medical Association, the Pharmaceutical Society, the National Pharmacists Union and the Wholesale Drug Trade Association. It is understood that the Committee intends to complete its work as speedily as possible. The publication of this formulary will be welcomed by medical men and dispensers, who are at present without an official guide as to the best substitutes for drugs which are now almost unobtainable and the best methods of compounding them for administration to patients. Apart from the few additions to the monographs of the British Pharmacopœia and alterations of a few monographs and lists of scarce drugs and suggested substitutes prepared by the Medical Research Council, no attempt has hitherto been made to compile a comprehensive book of formulæ for use during the period of emergency.

New Winter Forage Grasses

WINTER forage in Great Britain is a matter of first importance to the farmer and any new methods of ensuring a supply are worthy of careful consideration. W. Davis has brought forward the suggestion (*Emp. J. Agric.*, 8, 289; 1940) that pampas and tussac grasses, although exotic species, might profitably be grown for this purpose. Pampas grass (*Cortaderia selloana*) is a common ornamental plant in Britain, and though its leaves are coarse and harsh, it appears to be surprisingly palatable. It is both winter green and able to withstand drought, so that it would be productive just when other pasturage is short, and further, its tussock-forming habit would be specially valuable on hill pastures during periods of snow. The use of pampas grass has recently been investigated in New Zealand, where the results are promising.

Establishment from seed is slow, and it is probably best raised under nursery conditions and not grazed for at least a year. Chemical analyses show that it is considerably less nutritive than clover or young grass, but its relatively high yield (50 tons per acre per annum) and the fact that it is consumed *in situ*, thus avoiding labour costs, are compensating features. Tussac grass (*Poa flabellata*) is a much-prized forage plant in the Falkland Islands. Like pampas grass it is slow to establish, but once the initial stand is secured, the crop should go on indefinitely. In its natural habitat (the sea coast), this grass shelters numerous birds and seals, whose trampling and scratching cultivates the soil, while their excreta act as manure; inland the domestic fowl serves the same purpose. This combination of plant and animal life appears to be of fundamental importance to the healthy maintenance of the tussac plant. There seems no reason why these two grasses should not flourish in Great Britain, and both would probably merit a trial, as they would prove a valuable asset when the usual types of winter feed are scarce.

The Commonwealth Solar Observatory, Canberra

THE first report of the present Director of the Mt. Stromlo Observatory refers to the period May 1939–April 1940, though it also sketches the history of the Observatory since its establishment in 1910, and gives a brief account of the main observational programmes carried out since the first Director's appointment in 1924. The observations of solar radiation begun in 1926 have been completed, and a discussion of the results is promised. One of the most interesting conclusions is that the correlation between total solar radiation and duration of bright sunshine is so close as to be useful for derivation of the first quantity, the direct observation of which is difficult, from the second, which is a standard meteorological datum. Spectrohelioscopic and visual observations of the sun have been directed respectively to the detection and mapping of bright solar eruptions, several spectrograms of which have been obtained during 1939. As compared with flash spectra, these show a puzzling enhancement of low-excitation Fe I and Fe II lines.

A new programme of stellar observations is planned for the Reynolds 30-inch reflector which has been converted from Newtonian to Cassegrain form for the purpose. A single-prism spectrograph for spectroscopic parallaxes and a photo-electric photometer have been made for use at the Cassegrain focus. The work on cosmic radiation and atmospheric physics with which the name of the Observatory is especially associated has been carried on with a few modifications, chief among which are the discontinuance of the observations of atmospheric electricity and night-sky luminosity, and an extension of the work on cosmic rays and the ozone content of the atmosphere. With the establishment five miles away of an official Commonwealth meteorological station, many of the routine meteorological observations have been discontinued, though measurements having a direct bearing on other Observatory programmes are still being carried out. An impressive list of papers published during the year shows that the establishment is more than maintaining its high standing amongst southern hemisphere observatories.

New Russian Botanical Gardens

NEW botanical gardens, attached to the Armenian Branch of the Academy of Sciences of the U.S.S.R., were recently opened in Erivan, capital of the Soviet republic of Armenia. The gardens, which have some three thousand species of plants, have grown up during the course of five years on the dry, stony, desert soil between the settlements of Avan and Kanaker, near Erivan, which has been reclaimed. One of the most interesting departments of the gardens is the section devoted to the plants of Armenia. Ultimately, some 2,600 specimens of the flora of this republic will be collected there; the section already has 350 specimens. In the centre of this section has been built a pond, resembling the high mountain lake of Sevan. In the pond have been planted specimens of water plants of Armenia.. In the southern part of the gardens the Geographical Department is concentrated. More than half the area of the gardens is occupied by arboreal plants. The flower gardens are exceptionally rich; in the Avenue of Roses and Fountains more than a hundred varieties of roses have been planted.

Health in Sierra Leone

IN the latest annual report of the medical services of Sierra Leone, the director, Dr. W. P. H. Lightbody records a satisfactory state of general health among a population of about 100,000 and an absence of major epidemics. Nutrition in the undisturbed tribal communities is fairly satisfactory, but in Freetown, the capital, with a population of 55,000, and the adjacent villages there is some evidence of qualitative defects in diet, mainly an insufficiency of protein. Among the 250 European officials resident, the average annual sick leave per resident was 6·46 days, almost exactly the same as that of the 1,000 African officials. Only 3 European officials were invalided home during the year. Among the 495 European non-official residents the total number who went on sick leave was 73. The most frequent causes of death among the population in Freetown was malaria, which causes nearly twice as many deaths as tuberculosis, the second largest cause of mortality. Malaria also accounts for 43 per cent of the hospital cases in the colony.

The Wellcome Foundation Ltd.: Appointments

DR. R. A. O'BRIEN, who joined the staff of the Wellcome Physiological Research Laboratories at Beckenham in 1910 and became director in 1914, retired at the end of 1940. Dr. J. W. Trevan, who became head of the Pharmacological Section in 1920, has been appointed to succeed him. Dr. S. Smith, head of the Experimental Research Department and manager of the Wellcome Chemical Works at Dartford, has been appointed director of the Wellcome Chemical Research Laboratories at Beckenham. Dr. W. M. Duffin has also been transferred from Dartford to Beckenham. Mr. J. Russell has been appointed manager of the Wellcome Chemical Works. Mr. R. L. Grant has been appointed head of the Chemical Manufacturing Department on the retirement of Mr. W. Taylor.

Announcements

MR. AXEL L. WENNER-GREN, a Swedish industrialist, has given a cheque for ten thousand dollars to the University of Toronto for the extension of the work of its Geophysics Department.

THE following vital statistics for Scotland for the quarter ending June 30, 1940, have been published by the Registrar-General: The birth-rate was 18·6, the lowest ever recorded for the second quarter of any year since the institution of national registration in Scotland; the death rate was 12·8, and the infantile mortality 67, which is 1 below the average for second quarters of the year.

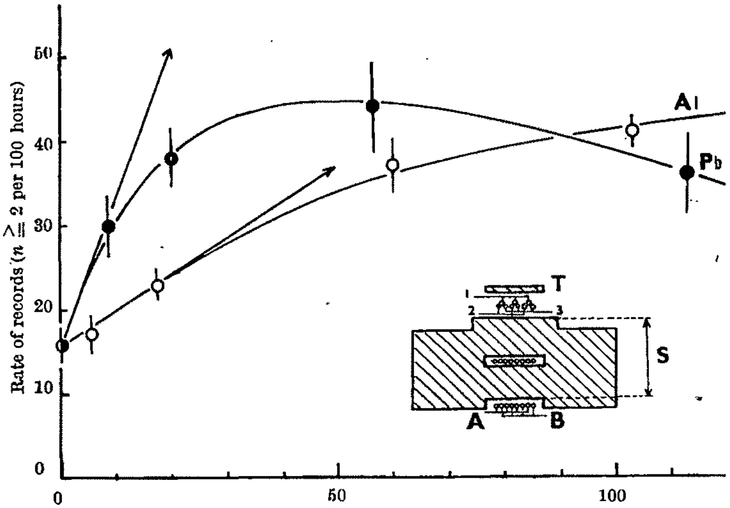
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Penetrating Cosmic Ray Showers

IN a recent communication[1] we gave some evidence for the existence of penetrating showers. We have now extended these observations to the transition curves of the showers in lead and in aluminium with the same experimental arrangement. Five-fold coincidences 1, 2, 3, A, B, and the number (n) of the counters H discharged simultaneously were recorded. Due to a slight change in the counter arrangement, our present rates are about 30 per cent higher than those reported previously. The results are summarized in Table 1 and the accompanying graph.



TRANSITION EFFECT OF PENETRATING COSMIC RAY SHOWERS IN LEAD AND ALUMINIUM. INSET, THE EXPERIMENTAL ARRANGEMENT

As before, it will be assumed that only the records with n greater than or equal to 2 represent genuine penetrating showers.

The initial slopes of the transition curves are significant for the cross-sections for shower production. It appears that the observed ratio of the slopes of the lead and aluminium curves is the same, within the experimental error, as the ratio of the corresponding cross-sections for the production of electron pairs by high-energy photons. The arrows drawn in the graph represent slopes having this ratio. The comparison of the lead and aluminium transition curves suggests therefore two possibilities. The first is that these showers are cascade showers. As pointed out before[1], this assumption implies the breakdown of the cascade theory for high-energy photons and electrons. The second is that the showers are due to meson pair production or a related process.

Experimental evidence for the occurrence of meson pairs has been obtained from cloud-chamber photographs by Herzog[2] and Powell[3]. Meson pairs seem, however, to occur rather infrequently, and it is doubtful whether or not they can account for the observed rate of penetrating showers.

TABLE 1.

T (cm. gm./cm.²)		Material	Rates per 100 hour	
			$n = 0-8$	$n \geqq 2$
0	Light roof only		$56 + 4$	16 ± 2
0·8	8·5	Lead	89 ± 6	$30 \pm 3{\cdot}5$
1·8	20·0		127 ± 6	$38 \pm 3{\cdot}5$
5·0	56·5		99 ± 8	$44 \pm 5{\cdot}5$
10·0	113·0		104 ± 9	36 ± 5
2·0	5·4	Aluminium	$73 \pm 5{\cdot}5$	$17 \pm 2{\cdot}5$
6·5	17·5		91 ± 5	23 ± 2
22·0	60		115 ± 6	$37 \pm 3{\cdot}5$
38·0	103		$136 \pm 5{\cdot}5$	41 ± 3

The theoretical cross-section for meson pair production by a photon of energy $\hbar\nu$ is, according to Booth and Wilson[4],

$$\underline{\Phi}\ \text{meson pair} = \frac{5}{9}\,\frac{e^2}{\hbar c}\left(\frac{c^2}{\mu c^2}\right)^2\frac{\hbar\nu}{\mu c^2},$$

where μ is rest mass of meson. From this we calculate the slope of the lead transition curve to be 0·0015 cm.$^{-1}$ hour^{-1}, while the observed slope is found to be 0·2 cm.$^{-1}$ hour^{-1}. Thus the observed effect is much larger than that predicted on the assumption of meson pairs.

Another difficulty arises from the fact that, as the records show, most of the showers contain many more than two particles (see Table 2).

TABLE 2.

Number of rays	0	1	2	3	4	5	6	7	8	Total
Observed frequency	854	911	184	139	130	108	80	85	49	2540

Thus in order to maintain the assumption of meson creation by photons, one has to assume that the process in question is a multiple one, that is, one photon giving rise to several mesons simultaneously; alternatively, one can assume that the photons arrive frequently in large groups creating several independent meson pairs simultaneously.

Whatever is the actual process for the production of these penetrating showers, it is probable that they are produced by the soft component of cosmic rays, because (a) saturation is reached at about $T = 5$ cm. lead, and (b) the cross-section of their production varies as Z^2. If the penetrating showers do consist of mesons, then the result that the cross-section for their formation varies as Z^2 is consistent with some other evidence. An estimation of the rate of mesons produced in the atmosphere by the process responsible for the penetrating showers gives a reasonable rate of meson production on the assumption that the cross-section varies as Z^2; but on the assumption that the cross-section varies as Z the rate obtained is too high.

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Pseudo-dominance in Polygenic Characters

F. W. Dry, P. R. McMahon and J. A. Sutherland in a recent communication[1] describe the inheritance of so-called halo-hairs (*N*-type) in lambs, which they found to have a multifactorial basis. *N*-type is, according to the authors, conditioned by a single factor dominant over the not-*N*-type (linked with the sex-influenced factor for horns, with crossing-over occurring about once in ten or twelve times).

But the authors found themselves a "little surprised" by one aspect of the situation, namely, that sometimes not-*N*-types (from *N*-type stock) produce *N*-type offspring. The authors suggest two explanations: two linked complementary factors for *N*-type, or dominigene hypothesis.

The observed facts require, I think, another interpretation. The reciprocal appearance of *N*-type in alternative generations is due to its polygenic basis, in which case an assumption of dominance, of dominance modifiers (dominigene) or of linkage is superfluous. The change in the usual dominance of *N*-type, or rather the appearance and disappearance of halo-hairs in succeeding generations, is a result of different assortment of modifiers, some of which (*I*) increase the number of halo-hairs, other of which (*D*) diminish it and cancel their appearance. If, for example, a lamb should inherit two modifiers *I*, each of which produces 100 halo-hairs per unit area, and four modifiers *D*, of which every one decreases the number of halo-hairs by 100, then this lamb would be not-*N*. These not-*N* animals mated together may produce lambs with halo-hairs (*N*-type) if they inherit more *I* genes than *D* genes. In the breeding experiment cited by Dry *et al.*, a not-*N* ram, son of an *N*-type son of the original *N* ram, was mated with not-*N* ewes (with no or few halo-hairs on the back), daughters of the original ram or of one or other of his *N*-type sons. The results were: 2 typical *N*-type and 9 not-*N* with halo-hairs absent or of low abundance on the back. These pseudo-dominant *N*-types appeared here from pseudo-recessive not-*N* parents, because these parents were polygenic and heterozygous for halo-hairs. The number of factors in the halo-hair character is probably a large one, and therefore the homozygous *N*-type, or homozygous not-*N* practically never occur. Consequently different recombinations are possible, producing the same visible type, *N*, and these pseudo-dominant *N*-types mated together give not-*N*; conversely the pseudo-recessive not-*N* (being polygenic and heterozygous) may produce *N*-type.

We cannot expect a constant ratio in F_2, but various ratios (sometimes accidentally a ratio 3 : 1), because the genotype of halo-hairs consists of many modifiers, and almost every polygenic *N*-type, or not-*N* depends upon a different assortment of genes.

For the same reason we can scarcely expect a ratio 1 : 1 in 'back-crosses', except by accident. This assumption is supported by results from 'back-crosses' which the authors obtained.

They say: "in back-crosses of heterozygous *N*-type (so regarded from their parentage) to not-*N*, some ratios are almost exactly 1 : 1, but in the offspring of some tested rams there is a deficiency of *N*-type, that is, an excess of lambs definitely not-*N*. Whether this deficiency of *N*-type is significant, and how it is to be interpreted if it is real, are matters calling for further experiment".

This "deficiency" is, we think, due to the fact that not only was the *N*-type heterozygous in these pseudo-back-crosses, but also the not-*N* was probably also a polygenic, heterozygous type, instead of a homozygous recessive. It was not a back-cross at all, but a mating of two heterozygous, polygenic types, which has given therefore different assortments of modifiers, and not a simple 1 : 1 ratio. This "deficiency" can be accounted for by the great excess of *D* modifiers in not-*N*.

The "dominance" of *N*-type seems to be an illusory one, and is not dependent on the dominance of the special gene for *N*-type. The *N*-type ram crossed with not-*N* ewes will sire *N*-type offspring, not because his halo-hair factor is dominant to not-*N*, but because the genotype of this ram includes a great number of modifiers *I*. For example, a (20 *I*, 2 *D*) ram mated to ewes of not-*N* (10 *I*, 12 *D*), having only a small excess of *D* modifiers, will give mostly *N*-type. Here we have a case of pseudo-dominance due to parents, with heterozygous polygenic character, transferring a great number of *I* modifiers to the following 'F_1' generation.

The appearance of not-*N* out of *N*-types by not-*N* is dependent on the presence of *D* modifiers in the *N*-type. These views are supported by the following statement made by Dry: "This *N* factor (or possibly *N* complex) sometimes comes to incomplete expression, so that the lambs fall a little short of the abundance of halo-hairs regarded as properly gross".

From the above we can see that the results obtained in F_1, or from 'back-crosses', are not always proof for dominance, that is, in cases where the character analysed is a quantitative one.

There are known in animals some other cases in which both parents of type *A* produce offspring of type *B*, and parents of type *B* produce *A* offspring. The inheritance of these cases (if polygenic) could be interpreted similarly as *reciprocal type of inheritance*. In polygenic characters we deal almost always with heterozygous material and consequently we can scarcely expect simple Mendelian ratios in F_2 or in back-crosses. The appearance or disappearance of a character in succeeding generations will depend on the numerical proportion of quantitative factors or modifiers. The excess of some will cause a given character to show (type *A*), and on the contrary the excess of the others will produce the opposite type *B*.

This reciprocal appearance of type A or type B will continue without special ratios in successive generations. It can be influenced by natural or artificial selection. After many generations of selection in one direction, there is produced an assortment of modifiers of the same type, and the observed character becomes pseudo-dominant.

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[1] NATURE, 145, 390 (1940).

Immunity from Cellular Changes in the Blood

CUMULATIVE evidence from a series of investigations on *Past. pestis*[1,2,3], specially in relation to active, passive and natural immunity and bactericidal tests *in vitro*, and *in vivo*, strongly suggested that the humoral factors could only be partly responsible for host resistance against a highly invasive organism like the plague bacillus.

During the course of studies on the cellular reactivity to plague infection it was observed that certain types of changes took place in the white cells of blood which, when studied by the supravital technique as described by Sabin and her collaborators[4,5,6], were found to be indicative of (*a*) active immunity, (*b*) passive immunity, and (*c*) susceptibility on the part of the experimental animal.

Bombay rats were employed for the study of active immunity since they are partially immune to plague infection, and a certain percentage of them always survived the test infective dose. Haffkine Institute inbred white mice, which have been shown to be most susceptible to plague[7], were used as controls as well as for passive protection tests. It was possible to study the cellular changes for a number of days in the same animal by bleeding it from the tail every morning and afternoon.

Both active and passive immunity were associated with the presence in the blood stream of those cells which have been variously described as clasmatocytes[8], histiocytes[9], and as wandering endothelial phagocytes[5].

(1) In active immunity there was a constant 'shower' of clasmatocytes which, along with an increase in the total number of leucocytes and abnormal functional activity on their part, indicated that the animal was going to survive. On the other hand, where, in a partially immune animal, the plague infection was going to prove fatal, the percentage of clasmatocytes was low and they were present for the first 48–72 hours only; the functional activity of both the monocytes and the granulocytes was below normal and the neutrophils gradually lost their motility and became rounded. Towards the end, the white blood cells presented a typical moth-eaten 'ground glass' appearance without vacuoles or granules. This picture always connoted a very grave prognosis and invariably ended fatally.

(2) In a susceptible animal, like the white mouse, no clasmatocytes were seen at any stage of infection. From the cellular point of view the animal took a downhill course almost from the very start. All the signs associated with grave prognosis developed by about the fourth day, and in spite of a total white cell count of 40–50,000 per c.mm., and a monocytic percentage as high as 25, the animal succumbed to infection on the fifth to seventh day.

(3) In passive immunity the presence of clasmatocytes was directly related to the envelope antibody—the protective component of an anti-plague serum[10]. There was, however, a threshold value below which the clasmatocytic cellular reaction was not observed. Above the threshold value the percentage of clasmatocytes and the duration of their presence in the blood stream depended on the amount of the envelope antibody administered.

The somatic component of an anti-plague serum, which in animal experiments was devoid of any protective value[3], was never found to be associated with the appearance of clasmatocytes in the blood stream.

The details of this investigation are being communicated elsewhere.

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Nov. 7.

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Pigments of *Iris pseudacorus*

A NUMBER of blue and purple varieties of the Iris family have been included in their "Survey of Anthocyanins" by G. M. and R. Robinson, who have specified the particular anthocyanidin present in each case. They have found, for example, that *Iris miranda*[1] contains a complex delphinidin diglycoside and that a malvidin 3 : 5 dimonoside mixed with what is probably a petunidin derivative is present in *Iris Kæmpferii*[2].

On the other hand, *Iris pseudacorus*, commonly known as the water-flag, owes its colour to the presence of carotinoids, a fact which was first established by van Wisselingh[3] from a cursory examination of the flowers by means of colour reactions.

We are at present engaged on a detailed investigation of the nature of the carotinoids present in *Iris pseudacorus*. We have succeeded in resolving the very complex mixture of pigments present into five different fractions. β-Carotene is present, and from the mixture of other pigments, which are xanthophylls, violaxanthin and lutein have been isolated and characterized. Whilst these constitute the major portion of the xanthophyll fraction, spectroscopic evidence disclosed the presence in very small amounts of what is probably zeaxanthin. In addition, a dark red wax-like substance, with absorption bands in carbon disulphide at 496, 465 and 436 μμ, was isolated. Kuhn and Winterstein[4] in their examination of the carotinoids of *Viola tricolor* obtained an unidentified coloured waxy product which had the same absorption maxima. The above xanthophylls are present in the petals in the ester form.

We hope to publish shortly a detailed account of this investigation elsewhere.

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Dec. 18.

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Influence of Purines, Creatinine and Creatine on the Oxidation of Vitamin C

IN a recent communication[1] evidence was presented to show the co-existence of oxidizing and protective mechanisms for vitamin C in plant tissues. While investigating the effect of various biologically important substances of very diverse nature, on the oxidation of vitamin C in presence and absence of $Cu^{\cdot\cdot}$, we have made some observations regarding the influence of purine derivatives, creatinine and creatine on the oxidation, which offers useful information regarding the nature of the protective mechanism existing in plant and animal tissues.

The oxidation of vitamin C was studied at *p*H 7·2 in presence of $Cu^{\cdot\cdot}$ in the Warburg manometers at 30°. The oxygen uptake was measured in the presence and absence of the substances under investigation, and the results are presented in the following table.

Ascorbic acid, 2 mgm.; $Cu^{\cdot\cdot}$, 0.71 μgm.; total volume 3 c.c. Air, 30°.

	Substance	Concentration *M*	μO_2 uptake	
			Time in minutes	
			15	30
Vitamin C + $Cu^{\cdot\cdot}$ +	None	—	66	130
,, ,, +	xanthine	0·00017	0	0
,, ,, +	uric acid	0·00015	0	0
,, ,, +	theophylline	0·00014	13	17
,, ,, +	theobromine	0·0007	65	120
,, ,, +	caffeine	0·00064	62	121
,, ,, +	creatinine	0·0011	5	10
,, ,, +	creatine	0·00095	62	130

The results show that the oxidation of vitamin C by $Cu^{\cdot\cdot}$ is completely inhibited by the purines—xanthine, uric acid and theophylline, in a final concentration of 0·00014–0·00017 *M*., while caffeine and theobromine even at higher concentrations have no influence on the oxidation. The imino group appears to exert influence on the inhibiting action of the purines, as only those of which the imino group is free (for example, xanthine, uric acid and theophylline) inhibit the oxidation, while those whose imino groups are methylated show no inhibitory effect (for example, caffeine). Further, the presence of methyl group in position 7 completely prevents the inhibiting action of the purines, although the other imino group is free (for example, theobromine). Thus the imino group in position 7 of the purine derivatives appears to exert a decisive influence on the oxidation of the vitamin.

An interesting difference between creatinine and creatine, the two important constituents of the muscle, is revealed by their influence on vitamin C oxidation. Although creatine has no influence, creatinine exerts powerful protection against the oxidation of the vitamin. Similar results were obtained when the oxidation of the vitamin was followed by titration with the indophenol dye.

In addition to glutathione and other thiol compounds which are known to exert similar protective action against the oxidation of vitamin C, the presence of purines and creatinine in the body may insure the existence of reduced vitamin C or prevent the oxidation of the vitamin by $Cu^{\cdot\cdot}$.

Further work on the mechanism of inhibition of the oxidation by the purine derivatives is in progress. Full details of the work will be published elsewhere.

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Nov. 1.

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[1] Giri, K. V., and Krishnamurthy, P. V., NATURE, **146**, 99 (1940).

Hydration of Carbon Dioxide and the Stability of Hypochlorite Aerosols

Powell[1] and Baker and Finn[2] have considered the effect of the slow hydrolysis of carbon dioxide on the stability of hypochlorite aerosols. The work of McBain[3] is quoted when in fact much subsequent work of greater accuracy has appeared; a summary of this work has recently been published[4]. In a series of experiments involving the accurate use of a difficult technique, Faurholt[5] measured the actual magnitudes of the rate constants for the reactions of carbon dioxide with water and hydroxide ion. The reaction with hydroxide ion is much the more rapid. The velocity of hydration in a given aqueous solution is thus a function of the *p*H, and can be calculated by summing the contributions to the rate by water molecules and hydroxide ions. In addition, the reaction is catalysed by bases and will be accelerated by anions of weak acids[6].

From these data the velocity of "changes occurring between the collision of carbon dioxide molecules in the air with droplets of the aerosol and the appearance of the corresponding hydrogen ion" can be easily estimated. It is noted[2] that the aerosols are decreasingly effective in acid, neutral, and alkaline solution. In alkaline solution carbonic acid would be produced from carbon dioxide more quickly than in acid or neutral solution; liberation of HOCl would occur more rapidly and loss of HOCl by evaporation would be more serious.

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Dec. 14.

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[1] Powell, NATURE, **146**, 401 (1940).
[2] Baker and Finn, NATURE, **146**, 747 (1940).
[3] McBain, *J. Chem. Soc.*, **101**, 814 (1912).
[4] Olson and Youle, *J. Amer. Chem. Soc.*, **62**, 1027 (1940).
[5] Faurholt, *J. chim. phys.*, **21**, 400 (1924).
[6] Roughton and Booth, *Biochem. J.*, **32**, 2049 (1938).

RESEARCH ITEMS

Fiction and Fact in Cultural Diffusion

WHEN, some years ago, battle was joined over the question of the diffusion of culture, it was categorically affirmed by members of the diffusionist school in anthropology that no element of culture, such as, for example, the wheel, was ever invented twice, but wherever it occurred it was a product of diffusion from a single centre of origin. Notwithstanding the obvious exaggeration of the statement in this extreme form, instances to the contrary susceptible of absolute demonstrable proof have not been found to be common. This has been especially true in one province, namely, the folk-tale. Here the argument for independent invention has to contend with a weight of evidence in the widespread occurrence of identities in character of motif and details of incident which, occurring time after time in a constant sequence, seem to preclude the probability of anything but a common origin. A familiar example is a folk-tale which occurs in a large number of variants distributed from India to Wales. Its motif is the faithful dog or other animal which is slain by its master on the evidence of bloodstains under the misapprehension that it has killed the child which it was its duty to protect. It occurs in the *Pañcatantra* as the story of the Brahman and the mongoose, and is widely current in India. In 1937 it was recorded among the Kotas of the Nilgiri Hills by Dr. D. G. Mandelbaum in the course of ethnological field-work, and has been studied for its bearing upon the diffusion problem by M. B. Emeneau with his collaboration (*Proc. Amer. Phil. Soc.*, **83**; 1940). The story as told among the Kotas deals not with ancient times, as is usual in their folk-tales, but professes to describe an event which actually took place "about eighteen years ago", the actors in the drama being named, and three of them, including the woman who killed the mongoose, and her son, the infant whom the mongoose saved, being still alive. Investigation in the tribe, and interviews with the persons involved, established the conviction that the event really happened and the story is not here an instance of a borrowed motif. It is suggested by the investigator that, failing acceptance of this conclusion, two alternatives are open—either that the record of an actual event was remade in the classical form, of which, however, the persons concerned and narrators deny any knowledge, or that subconscious knowledge of the classical story forced the woman to act as she did. This latter explanation would, the author points out, involve a peculiarly subtle form of diffusion.

Flint Flakes of the Crag Sea Floor

TRAPS and difficulties of interpretation in geology and prehistory are reviewed by S. Hazzledine Warren in his recent presidential address to the Essex Field Club (*Essex Naturalist*, **27**; 1940). Among these he discusses the Crag sea floor and its flaked flints—"the most important and the most controversial problem of prehistory". The discovery of the remains of the lower jaw of *Elephas meridionalis* at Runton a few years ago suggests by its associations—it lay in the middle of the sands of the Weybourne Crag under the rolled pebble bed at the base of the forest bed with fossil marine shells over, around and under it—that in the presence of a scouring current where sedimentation was arrested, such bones, when the carcass had drifted out to sea, would become broken up and accumulate as a rolled bone bed on the sea floor. Further, phosphatization is a sub-marine product, while the suggestion is in harmony with the rise in the Crag sea floor which brings the Crag sea level to above 300 ft. O.D. The associations of the Suffolk bone bed fall naturally into this epoch of submergence. At all the varying depths of the Crag Sea there is no visible break in marine continuity from the bone bed and stone bed to the overlying sediments. The most remarkable phenomenon of this ancient sea floor is the vast quantity of flaking that is distributed over it. Is the origin of this flaking Eolithic or natural? It has been argued (Prehist. Congress "Handbook"; 1932) that the Crag implements are contemporary with the basement bone bed and are not 'derived'. Drifting, however, must not be excluded nor can the inference that the bone bed was occupied by Tertiary man be accepted, unless he was of the mermaid race. In regard to the artificial origin of certain crude flakes, doubt arises from the observation of the effect of the passage of cart-wheels over flint on a new road. Exact reproduction of the forms claimed as eoliths are produced thereby. Further, eoliths are associated in geological deposits with striations that indicate that very movement under pressure that is required to produce flaking. During the last few years a swing of the pendulum has set in, and the realities of flaking by pressure are beginning to be better appreciated. The ultimate test lies in first-hand observation of the concrete material.

Isotope Exchange in Organic Compounds

Deuterium has been used as an indicator in the study of three-carbon tautomeric systems in which one isomeride is produced in large predominance. A study of an equilibrium state which is more balanced is provided by the system composed of Δ-pentenoic acid $CH_3.CH_2{\cdot}CH{:}CH.CO_2H$, Δ^{β}-pentenoic acid. $CH_3.CH{:}CH.CH_2CO_2H$, and β-hydroxyvaleric acid $CH_3.CH_2CH(OH).CH_2.CO_2H$ by D. J. G. Ives and R. H. Kerlogue (*J. Chem. Soc.*, 1362; 1940), which are involved in a 'triangular' system, each member being in direct equilibrium with the other two in an alkali-catalysed isomerization in water. This isomerization proceeds mostly by direct prototropic change but to a less extent by addition and subtraction of water, with the formation of the β-hydroxyacid as an intermediate. The deuterium exchange reaction was studied in a solvent containing deuterium oxide, and the results, although not investigated in detail, are in general conformity with the above reaction mechanism and indicate that a bimolecular mechanism is concerned in the prototropic isomerization.

A Theory of the Structure and Formation of Antibodies

A PAPER by L. Pauling (*J. Amer. Chem. Soc.*, **62**, 2643; 1940) develops a theory of the structure and process of formation of antibodies and the nature of serological reactions which takes account of the present knowledge of the structure and properties of simple molecules as well as most of the direct empirical information about antibodies. An attempt is made to develop the simplest structure for a molecule with the properties observed for antibodies and the simplest reasonable process for its formation. It is assumed that antibodies differ from normal serum globulin only in the way in which the two end parts of the polypeptide chain are coiled. These parts have many possible configurations and under the influence of an antigen molecule assume configurations complementary to surface regions of the antigen, thus forming two active ends. After the freeing of one end and the liberation of the central part of the chain, this part of the chain folds up to form the central part of the antibody molecule, with two oppositely directed ends able to attach themselves to two antigen molecules. These processes are made clear in the paper by several diagrams. It is shown in detail that most of the reported experimental results are compatible with the theory.

Properties of Liquids in Small Capillaries

SOME experiments by J. L. Shereshefsky (*J. Amer. Chem. Soc.*, **50**, 2715 ; 1928) showed that the observed lowering of vapour pressure of a liquid in capillaries of 2 to 6 microns in radius was considerably larger than that calculated by Kelvin's equation. This was attributed to an increase in surface tension in the small capillaries. In quartz tubes of radius 5 μ or greater, normal values were found with water, but abnormal values in tubes of 2·07 μ in radius. L. H. Cohan and G. E. Meyer (*J. Amer. Chem. Soc.*, **62**, 2715 ; 1940) have now made further experiments to find if the surface tension changes in small capillaries. Water and toluene were measured in pyrex glass capillaries of radii as small as 2 μ. The rises were large, in some cases more than 250 cm. The results indicated that the surface tensions and densities of the two liquids do not vary from their normal values within the limit of accuracy of the experiments, ± 5 per cent. The increase in surface tension thus cannot be accepted as an explanation of the abnormal vapour pressure lowerings found by Shereshefsky.

Quenching of the Resonance Radiation of Sodium

R. G. W. Norrish and W. MacF. Smith have reported the results of an experimental study designed to elucidate the behaviour of different molecules in quenching the resonance radiation of sodium (*Proc. Roy. Soc.*, A, **176**, 295 ; Nov. 1940). By using different homologous series, an attempt has been made to assess the specific qualities of molecular structure which can give rise to quenching. Quantitative indications were got from the strongly quenching gases, the saturated hydrocarbons and the inert gases, but only semi-quantitative indications from the weakly quenching gases, the unsaturated hydrocarbons and the amines. The difference in behaviour of the two groups of gases is too pronounced to be explained in terms of the discrepancy between the amount of energy the sodium atom gives up and the quenching molecule can receive. Unsaturation in the molecule seems to be the deciding factor. Within any one series the number of atoms in the molecule apart from the unsaturated centre appears to have little influence on the quenching ability, which may be regarded as proceeding from a centre of unsaturation. From a qualitative discussion of the results in the light of the Stearn and Eyring theory of non-adiabatic reactions, it is concluded that, in the terminology of the theory of the intermediate complex, the presence of unsaturation manifests itself in a relatively large transmission coefficient.

Periodicity in the Corona

K. G. MELDAHL has published a small work of 14 pages entitled "Tidal Forces in the Sun's Corona Due to Planets Compared with Wolf's Sunspot Curves" (Copenhagen : Berlingske Forlag) which is a continuation of his general investigation of the tidal forces in the corona (see NATURE, **144**, 726 ; Oct. 28, 1939). The author starts with a disturbance at 15° latitude as the basis, the daily rotation at this position being 14·48°, and deals with the relative and absolute tidal force periods, and finally with the inverse of their products : this is the velocity of rotation which is utilized for combining the periods and attaining the final results. These periods, combined in various ways, denote the time elapsed between repetitions of the mutual positions of bodies without regard to orientation in space. Looking for the possible results of combining numerical data, four solutions satisfy the condition that the result shall be negative, and of these it is found that a period of 11·279 years is derived from V+E+J−(M+S), these letters referring in order to Venus, Earth, Jupiter, Mercury, and Saturn. As explained in the previous review, Mars is neglected, as its tidal force is only about 3 per cent that of the earth. The half-periods of the planets were naturally used, in accordance with the tidal law, and the result is the Wolf's Zurich curves of sunspot periods, as shown in a figure. Meldahl considers that this affords additional proof of the correctness of the tidal force effect. The latitude 15° was selected because data for this region were available, but if latitude 13° is chosen a period of 11·125 years would result. It is claimed that a 9·548 years period obtained from V+E+S−(M+J) furnishes another proof of the tidal forces by apparently causing a beat in the curve in 1837 and a minimum region about 62 years later.

Star-Streaming and Spectral Type

W. M. Smart and T. R. Tannahill made an analysis (*Mon. Not. Roy. Astro. Soc.*, **100**, 1 ; November 1939), on the two-streams hypothesis, of the proper motions of stars of all spectral types in the Cape Astrographic Zone, the limit of magnitude being 9·0 on the C.P.D. scale. They now give a similar analysis for the spectral subdivisions *A*5–*F*5, *F*8–*G*5, *K*0–*M*, and also for the 11,448 stars in the spectral range *A*5–*M* (*Mon. Not. Roy. Astro. Soc.*, **100**, 8–9 ; June 1940). The results for the drift constants, the vertex of the star-streaming and the solar motion are given in tables for the various spectral groups, and it is interesting to notice that the stars in each spectral group are divided fairly equally between Drift i and Drift ii. In spectral groups *F*8–*G*5, the ratio of the number of stars in the two drifts is 1·038, and the close equality prevails also in the numbers (Table 3) dealing with the vertex of star-streaming and solar motion. This table shows that the longitude of the vertex is, on the average, about 15° higher than that of the galactic centre. The ellipsoidal constants have been derived by the method previously described by Smart, and are in good agreement with the values derived by Jackson from the same data but by a different method. The ratio of the axes of the velocity ellipsoid for the *A*5–*M* stars is 0·64, and this agrees well with Jackson's value, 0·60.

UTILIZATION OF ELECTRICITY IN AGRICULTURE AND HORTICULTURE

IN the report referred to below*, which was prepared originally for the guidance of the Electrical Research Association, Mr. C. A. Cameron Brown gives a very complete review of the experimental and research side of rural electrification. It is estimated that out of about a quarter of a million farms in Great Britain which are already, or are likely soon to be, within reasonable reach of an electric supply, only about one in eight has yet been connected. The main difficulty in the way of further development is the relatively high cost of providing a supply to the average farm. Most electrical development is based on the expectation that a new customer will bring in an annual revenue equal to about 20 per cent of the capital cost of connecting him to the system. Under present conditions, however, the average annual revenue from a newly-connected farm is unlikely to exceed £25; while the cost of connexion will almost certainly be considerably more than five times this amount. There are two possible lines along which a solution of this difficulty might be sought: to lower costs of connexion by simplification, standardization or other means; or to increase potential revenue by encouraging the wider application of electrical power on the farm; and it is to consideration of the second of these that the report is mainly directed.

Of the various fields of activity in which farmers use power, tillage is by far the largest and most important; but, from the point of view of electrical development, is one of the least hopeful. Battery-driven tractors are out of the question, while electrically operated winding sets, working on the same principle as steam ploughing engines, are too restricted in operation for the present-day farmer. The only real possibility lies in the electrically driven tractor fed from a stationary supply point, through a flexible cable which is paid out and picked up automatically as the machine manœuvres. The main technical problem is the design of a cable-winding mechanism which will give the tractor sufficient flexibility of movement; and it seems unlikely that electrically operated outfits will ever be able to undertake much field work beyond ploughing and the heavier cultivations. Their development would therefore seem to be quite out of tune with the present overwhelming tendency towards all-purpose tractors which can also be used for the after-cultivations of growing crops, and in haymaking, harvesting, transport and so on. Some practical progress in electrical tillage has, however, been made in New Zealand.

In the barnyard, where power may be needed for water supply, grinding and a whole range of food preparing operations, as well as for such subsidiary work as wood-sawing, the position is much more hopeful. In nearly all such operations, electrical power has the advantage of greater convenience; and although few directly comparable costs are available, there is good reason to believe that electric motors will give lower overall running costs than stationary internal combustion engines, provided that electrical power is available at rather less than 2*d*. per kilowatt hour. There is, however, room for developmental research: both into the kind of layout which will derive the greatest benefit from electrical working, and into the load factor of barn machinery. At present the typical barnyard engine is a fairly large one of, say, 10–15 h.p., which is regularly called upon to develop full power but which nevertheless will probably not do more than 500 hours of work in a year. As the report points out, running conditions as irregular as these are fundamentally wrong whatever the form of power used, and would be quite unacceptable to the supply engineer who might have to deal with some hundreds of similar cases in his distribution area. The remedy is, of course, the use of lower powered units which run for longer periods, but these will lead to uneconomical labour charges if they are not made practically automatic in operation, while to make them so will involve a considerable measure of barnyard reorganization. The Association's research programme includes some experimental work on these lines, and in the particular case of the grinding mill—the worst offender from the power factor point of view—useful progress has already been made.

In some of the more specialized branches of agriculture, electricity has more to offer than the mere replacement of one form of power by another. In dairying it has overwhelming advantages on grounds of cleanliness alone; while in poultry husbandry it has already been largely responsible for a great increase in chick production. At one time electrical incubation and rearing were regarded as being suitable only for raising 'soft' chicks for the table. Now, however, it is being realized that the same methods are even more suitable for the rearing of hardy stock. It has been found in practice that the dangers of loss from temporary failure of supply are not so serious as was once thought possible, and with the development in the future of storage brooder heating units these dangers will be reduced still further.

In horticulture, less progress has been made because the industry depends mainly on sources of low-grade heat with which, at any rate in the larger-scale commercial applications, it is difficult for electricity to compete economically. In small-scale work and in the amateur greenhouse, on the other hand, sheer economy of working is not always the ruling consideration. In horticulture generally, however, there is plenty of scope for research and experiment: on the use of heating cables for hotbeds, on soil sterilization, and on the use of light for irradiating growing plants.

The last of these is only one of a number of very interesting future possibilities which are dealt with separately in the concluding section of the report. Among others that may be mentioned are crop drying, grain sprouting, electro-culture and ultra-violet irradiation. At the moment their interest may be academic rather than practical; yet they may very well change the face of agriculture in the not too distant future.

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* A Critical Study of the Application of Electricity to Agriculture and Horticulture. By C. A. Cameron Brown. (Technical Report Ref. W/T2.) Pp. 84. (London: British Electrical and Allied Industries Research Association, 1940.) 2*s*.

The report as a whole deals with the situation as it existed at the outbreak of war; and it cannot be expected that much further progress will be made within the next year or two. At the same time, as is pointed out in an introductory footnote, the War has brought many of the potential advantages of electricity into even sharper relief. From a shortage of cod liver oil comes a new interest in ultra-violet irradiation; the more frequent use of female labour makes ease of control an important consideration; scarcity of imported feeding stuffs encourages a return to the earlier practice of grinding and preparing foodstuffs on the farm; and so on. But, in his final summary, the author of the report takes the longer view and looks forward to the time, twenty-five or forty years hence, when on all but a small proportion of unreachable farms electricity is used as a matter of course, for all stationary power and for all heating operations. This state of affairs is very likely to come about—not, perhaps, as the direct result of technical or agricultural research, but as a matter of sociological progress. The future of agriculture in Great Britain is bound to depend a great deal on giving the rural dweller his due share of urban amenities, and in America it is recognized already that the seller of electric kettles, cookers and washing machines plays a great part in the spread of farm electrification.

FORESTRY IN AFRICA

IT is interesting to note in recent annual forestry reports how what may be termed a correct and long-sighted forest policy is gradually becoming recognized by the civil administration as a matter which can no longer be left to chance. This has recently been exemplified in NATURE. In the Gold Coast annual report (1938–39, Govt. Printer, Accra, 1939) the Conservator, in discussing the history of the forests, says that though some thirty-one years ago the indirect value of the maintenance of a proportion of tropical lands under forest was clearly stressed, yet the progress of reserving forests for the use of future generations, the maintenance of soil fertility, and so forth, has not proved an easy task. Forests, of necessity, occupy land, he says; and difficulties are increased when all the land, although surplus to immediate wants, is owned by a community with an unawakened national sense; to the individuals the cash resulting from an immediate sale is much to be preferred to the somewhat abstruse prospects from reservation in favour of future generations or a possible improvement in their water supplies. The failure to press for a more rapid selection of forests for reserves when surplus land was plentiful has resulted in an increasing opposition which education and propaganda are only gradually lessening; while the remaining forests of the Colony can no longer be regarded as excessive if the happiness and health of the community are to be assured.

In the Nigerian forestry report for 1939 (Govt. Printer, Lagos, 1940) the Conservator re-defines the aims of forestry in that part of West Africa on the well-known lines which have been so often in the past disregarded by the Governments. He sounds a wise note, too often neglected, that the productive motive, though secondary (it has usually been placed first), is an important one. "If," he says, "forest, shelterbelts and shade trees have to be maintained for protection, it is clear that the fullest possible use should be made of them, and this can best be effected by fostering African industries using forest produce as raw material." These industries, as was foreseen several years ago by senior French district administrative officers in the Ivory Coast, will in the future be more important in the economy of the country than any export trade in timber overseas. It is a step in advance that the head of a West African Forest Department should at length express this important view. The Conservator remarks that the Department is becoming continually more involved, with other rural departments, in the study of the wider problems of land use and land planning. But here again new forest reservation, so urgently needed, proceeds slowly in the south owing to political and legal difficulties and problems of land tenure; and this in spite of the fact that all the forms of deterioration—of soil, climate and water supply—are in active progress in various parts of the southern provinces. There can be little hope of more than local remedy until the chaotic situation as regards land tenure is resolutely tackled.

The annual forestry report for Kenya for 1939 (Govt. Printer, Nairobi, 1940) strikes rather a different note. The outbreak of war has caused some reduction of the staff (junior officers allowed to join or called up to join the Army, which has been the case in both Nigeria and the Gold Coast), but has considerably increased the demand for forest produce. This latter and the increased revenue thereby realized might have proved of some satisfaction to the Department—especially the revival in the old export trade of boritis (mangrove) poles—were it not for the former factor. The demand for produce from the forests was increased during the latter part of the year by War Department demands. At all sawmills trade was fairly brisk, and several millers increased their output considerably by improved organization and efficiency. Unfortunately the urgent military demand for building timber has meant that air-seasoning has not been possible prior to the delivery of the timber.

Regrettable as this may seem, equally unfortunate is the fact that most of the timber requisitioned by the military authorities in war-time is utilized for purposes often ephemeral and in any event has a comparatively short life. A far more important point is the factor that, with a reduced staff, who is to undertake the necessary supervision over the extra fellings which are to take place? The limit to further indiscriminate fellings and resultant ultimate disappearance of the African forests has been reached, or is perilously close. If war fellings are to take place unchecked in forests the volume content of which is but imperfectly known, neither administration nor the local forest department is fulfilling its true functions to the native communities.

THE BRITISH PHARMACOPŒIA IN WAR-TIME

THE text is available of a further addendum to the British Pharmacopœia. Published under the direction of the General Medical Council, it became effective on January 1. Of main interest is the inclusion of monographs on a number of synthetic substances, formerly of foreign manufacture, and first introduced to the medical profession under proprietary names, which are now produced in Great Britain, in some cases under licences granted by the Comptroller-General of Patents.

The probability that certain 'new remedies' of this type would be introduced into the British Pharmacopœia in due course has already been mentioned in NATURE (August 31, p. 309). In selecting eleven of the more important of these products for official recognition the authority has adopted new names for their pharmacopœial titles. The substances under their official designations are as follows, the names in brackets being those under which they were first known: bromethol (avertin), carbachol (doryl), hexobarbitone and soluble hexobarbitone (evipan sodium), iodoxyl (uroselectan-B), leptazol (cardiazol), mepacrine hydrochloride (atebrin), mepacrine methanesulphonate (atebrin musonate), nikethamide (coramine), phemitone (prominal), and stibophen (fouadin).

The purpose of laying down standards for these products is to ensure that important synthetic remedies previously obtained from abroad will continue to be available in medical practice; the substances can be so adequately tested for identity and purity by chemical means that no question of the equivalence of the British preparations can arise.

Other monographs which have been added are on aneurine hydrochloride, chlorocresol, and paste of tannic acid. The inclusion of aneurine hydrochloride is of general interest since it is the vitamin—B_1—which it is proposed to add to white bread to replace the loss resulting from milling. Aneurine, which is also known as thiamine, plays an important part in carbohydrate metabolism. Chlorocresol (*para*chloro-*meta*cresol) has been added because of its use as a bactericide in sterilizing solutions for injection and as a bacteriostatic preservative in certain solutions; it is one of the ingredients of the newly introduced paste of tannic acid.

Monographs which are amended are those on atropine sulphate, injection of bismuth salicylate, hard soap and soft soap. The only change in the case of atropine sulphate is in the official statement of the melting point; for lead plaster arachis oil may be used in place of olive oil, and the alterations in the monographs on the soaps are made with the object of enlarging the choice of vegetable oils and authorizing the use of soda instead of potash in the process of saponification.

The addendum also embodies monographs which had already been amended by notices in the *Gazette*, the items concerned being lead plaster, injection of mercury, injection of mercurous chloride, strong ointment of mercury and ipecacuanha. Amendments which have been made in the appendixes, which relate to tests, are naturally the result of the additions to the British Pharmacopœia and the alterations which have been effected by the new addendum.

FORTHCOMING EVENTS

Monday, January 13

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 3 p.m.—Prof. H. A. Harris: "Growth in General".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Prof. O. T. Jones, F.R.S., and Mr. W. V. Lewis: "Water Levels in the Thetford Meres".

Tuesday, January 14

ILLUMINATING ENGINEERING SOCIETY (at 32 Victoria Street, London, S.W.1), at 2.30 p.m.—Dr. W. D. Wright: "The Fundamental Principles of Vision in Very Weak Light".

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 3 p.m.—Prof. H. A. Harris: "The Anatomy and Physiology of Locomotion and Posture".

Wednesday, January 15

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Miss Caroline Haslett: "Women in Industry".

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at the Royal Society of Medicine, 1 Wimpole Street, London, W.1), at 3 p.m.—Prof. H. A. Harris: "The Inherent Weaknesses of the Human Body with reference to Orthopædic Practice".

Thursday, January 16

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 2.15 p.m.—Prof. P. A. Buxton: "Some Recent Work on the Louse".

PHARMACEUTICAL SOCIETY (at 17 Bloomsbury Square, London, W.C.1), at 2.30 p.m.—Mr. Arthur Mortimer: "Drug Supplies in War Time".

Friday, January 17

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. G. E. Manville: "Optical Instruments: particularly Large Astronomical Telescopes".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ASSISTANT ENGINEER FOR THE MALAYAN PUBLIC WORKS SERVICE—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9306).

HEAD OF DEPARTMENT OF TRAINING COLLEGE AND SCHOOL OF DOMESTIC SCIENCE of the Witwatersrand Technical College, Johannesburg—Frank Ross and Co., 9 Fenchurch Avenue, London, E.C.3.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

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UTILIZATION OF MAN POWER

THE new appeal for volunteers for training for war work and the emphasis placed on the need for the employment and training of women show that the magnitude of the man-power question is now at last being recognized. Mr. Bevin has indeed, during the time in which he has exercised his immense powers of control over labour and industry, been fully alive to the importance of the human factor. He cannot be accused of being unmindful of the findings of the Industrial Health Research Board, and the stress he has laid in various speeches on the provision of canteens, communal feeding, and the safeguarding of health have indicated his profound concern with the maintenance of morale and health. There is, indeed, no room whatever for doubts as to the Minister of Labour and National Service holding a long-term view of industrial efficiency, and as to his determination to allow no short-sighted views of output and hours of work to impair the physical, mental and moral capacities of the workers on whose endurance, skill and enthusiasm we depend for long-sustained production.

Such uneasiness as may exist in regard to the man-power position and its handling arises largely from the same type of considerations as have led to criticisms of the scope and functions of the new Ministry of Works and Buildings. It is a question of the co-ordination and direction of our war-effort to the maximum efficiency. It is to be hoped that the new executive committee of Cabinet Ministers announced on January 6 will secure a measure of the co-operation which is imperative.

Examples of this lack of co-ordination are easily found. The Limitation of Supplies Order is part of a consistent policy of the Board of Trade to cut down severely the volume of manufacture for the home market. The aim of this policy is not merely the restriction of spending by the general public, but also, and equally important, the reduction of effort in non-essential industries. Similarly, the change of export policy from one of indiscriminate encouragement of all exports to one of selective encouragement is bound to result in displacement of labour in the manufacturing industries, distribution and perhaps especially among the retail shopkeepers.

In theory, the labour thus displaced is available for, and should be taken up by, the munitions industries. In practice, despite the somewhat misleading figures issued by the Ministry of Labour, it is not being taken up, or at least absorbed, with the completeness and rapidity that are desirable. There is little evidence of effort specifically designed to assist the transition by training in advance.

The failure of the Board of Trade and Ministry of Labour to dovetail is the more serious in view of the strain which sustained air attack places on the civil population. Consideration of the welfare side of the transition of labour, educational work designed to prepare men and women for change, to free them from unnecessary hardship or anxiety, is just as important a factor in the smooth supply of the million more workers required by next August for the armaments plan of the Ministry of Labour as it is in the handling of the dilution problem and the training of fresh labour in the shops, both as regards employers and individual workers. The Government is perhaps awaiting the results of the survey on which Sir William Beveridge is engaged, before committing itself to a more definite policy. It is time more was heard about this survey.

The million workers required can only be obtained by ruthlessly squeezing labour out of the non-essential industries, and there is little evidence that the reduction of the personnel of the non-essential industries is being carried through in anything but the most haphazard way. The Government has been silent, too, about the pooling of enterprises, or about compensation for works closed down—factors which also affect morale. There is no indication of prompt and firm administrative action to prevent wastage among labour evacuated from the coasts, or among that, often highly skilled, temporarily displaced by air-raid attacks.

The simultaneous immensely larger demands of the fighting services for men, who will have to be provided from the same source and even from among present war workers, makes the ruthless elimination of waste of man-power of the utmost importance. Civil defence workers provide a further complication. The balance between the different branches of civil defence—fire services, first aid, rescue and demolition services—requires reconsideration in the light of experience of recent months. Moreover, the most effective use of the minimum number of full-time workers consistent with safety cannot be secured without efficient organization of the much larger body of part-time workers, whose morale and efficiency, it should be remembered, are determined both by that of the community in which they live and of the industry in which they are engaged. Much more might be done to ensure the rational use of such part-time services in ways which would foster their keenness and loyalty without putting intolerable strain on their health or devotion.

Such organization of civil defence services, including the provision of reasonable amenities during the additional strain which weather and darkness impose during the winter months, is an essential part of the efficient use of our man-power resources. The wise use of military resources in the more technical tasks of clearance and repair to reinforce labour already available is an example of the type of elasticity and co-ordination required.

As already suggested, much more might be done to minimize the stress and strain of the vast change-over required. Most important at the present moment, however, is the problem of the large-scale training of men and women whose normal jobs have come to an end. Moreover, something in the nature of a system of priorities may be demanded in regard to man-power as well as supplies.

What must be realized is that the new demands involve a profound disturbance, not merely of our standards of living, but also of our domestic life. The great army of women workers required for our munition factories will not be recruited without grave social problems being encountered, both within industry and without. The reactions on the supply of helpers for many of the voluntary services of all kinds may be seriously adverse.

The importance of the proper distribution of skilled labour is not yet sufficiently recognized. Until it is distributed among the thousands of firms in the manner best suited to the mass production of munitions, we shall not achieve our maximum production, nor indeed be able to utilize effectively in the less skilled jobs our full resources of man- or woman-power. Skilled labour of any kind must in fact be regarded as first the possession of the State, rather than of any individual firm.

Recognition of key workers, especially tool-room workers and machine-setters, as a sort of national pool must be followed by proposals to make such a declaration more effective in the day-to-day hiring and employment of such industrial craftsmen. Further, this is true also of the training of the rank and file of fresh workers to do the less skilled jobs. These men and women are being trained to enter industry at whatever point their services may be needed, and the particular employer of any trainee is no more than the agent of the Government, upon whose production programme the scale and incidence of these extra labour requirements directly depend.

Mr. Bevin's references to the importance of psychological factors as a justification for not resorting to compulsion may in theory be sound enough. But there must be no squeamishness in dealing with anything allied to obstructive tendencies. There are already indications of undue deference, if not subservience, to vested interests in various fields, including that of food policy and agriculture, which endanger the high mood in which the nation faced the perils of early summer.

The need for wise planning and central direction of our man-power policy is cardinal, but the central machinery and plan must function smoothly. Just as the National Register can only be used to complete or perfect the main process of transfer or adjustment initiated in other ways, so the increasing attention to the safety of workers in factories, the improvement of amenities, the provision of canteens, the placing of workers to eliminate unnecessary travelling, and the avoidance of excessive hours of work, are designed essentially to ensure that man-hours vital to output are not lost by allowing conditions to arise that impair health and efficiency.

As already emphasized, such factors have to be considered in relation to the conditions of the civil population as a whole. Billeting and dispersal plans prepared to facilitate uninterrupted industrial production cannot be considered apart from arrangements made in regard to the evacuation of school children or other special classes of the community. Education itself must be considered in reference to the *morale* of the adolescent population and the future supply of juvenile workers throughout the national life. Moreover, there is still evidence of failure to make full use of the available services of special types of worker; as, for example, of biologists, or of various classes of friendly aliens at present interned, though the recent orders for registration of the latter for employment is a step in the right direction.

The seriousness of the challenge which is now thrown down to us by night-bombing and by the attacks on our shipping must not be mistaken. No prejudices must stand in the way of the gigantic effort demanded of us. However severe those demands, or drastic the sacrifices they may involve of ways of living and freedom, it is certain that if they are presented with imagination and understanding, they will evoke as great a response as the disasters and perils through which we have already passed.

PHYSICS IN MODERN LIFE

Physical Science in Art and Industry
By Dr. E. G. Richardson. Pp. xi + 293 + 6 plates. (London: English Universities Press, Ltd., 1940.) 15*s*. net.

IN a specialist age such as the present, there must be a grievous loss of that legitimate pleasure which derives from the possession of knowledge over a wide field of human endeavour. Again, it is clear that much needless duplication of effort is continually going on, because people wholly absorbed in prosecuting one particular quest (probably with great zeal and application) are partly or wholly ignorant of what others are doing in another sphere, and whose methods might readily be adapted with very little trouble. There seems to be no ready-made cure for this state of affairs. Experience shows that even the most watertight and elaborate system of cross-references to cognate subjects fails to inspire us with a keen desire to look over the wall into our neighbour's garden.

Dr. Richardson, however, is a missionary. He has taken upon himself the task of discussing anything and everything—so far as the compass of his book permits—which physics can do in modern life. A random glance at the index produced such entries as 'cotton', 'decibels' and 'tilth'; from such an assortment, the scope of the volume can be envisaged. The author's style is easy, even perhaps colloquial here and there, and certainly the reader will have few dull moments, as he is swept along with an enthusiasm almost contagious.

The physics of locomotion occupy three chapters: these are followed by others dealing with communication, pottery, cooking, the farm, hydrology, mining, fine art and archæology, building materials, architecture, music, textiles and war. (It is a relief that the last-named is quite short, and that there is no inclination for its subject-matter to seep through into the rest of the book.)

Naturally, a work such as this offers unrivalled opportunities for any reviewer to dwell upon omissions, and some readers, too, will find their pet notions unrecorded; nevertheless, it is astonishing how complete and coherent the treatment is, and this without any obvious tendency to 'write round the references'.

To make a few specific comments: the section on aeroplanes contains an excellent description of the theory of similitude—and its relation to models—without the introduction of mathematical machinery. This is an example of the way in which Dr. Richardson will probably succeed in helping people to realize that there is such a subject, and that having done that, there is a fair chance that they may discipline themselves to appreciate its beauty when handled analytically.

The development of the locomotive is well brought out. A point which might have been worth making here is that the remarkable capacity for speed shown by engines of recent types (even with coupled wheels of relatively small diameter) is due almost entirely to radical improvements in 'front-end' design, and the study of the flowing properties of highly superheated steam. The speeds reached by the 'singles' of last century were not, generally speaking, very noteworthy (as the author truly points out), a fact mainly attributable to their unscientifically conceived ports and blast-pipes.

The wheel now turns full circle, and the reader may re-open these pages to find himself engrossed in the technics of art. It would have been kind if he had been directed towards that remarkable publication "Technical Studies in the Field of the Fine Arts" (Fogg Art Museum, Harvard University), which, for several years past, has been disseminating knowledge of just the sort which—in this particular domain—Dr. Richardson is so rightly anxious to increase, and for which he is striving to gain appreciation. In this connexion, Fink's ingenious researches into the cleaning of pottery by electro-endosmosis would have made a charming pendant to the chapter on ceramics.

Thus one can go on: it is an unending theme, as limitless as the powers of applied physics themselves. This volume should be widely read; schools would do well to add it to their libraries without question; for other folk it will be found to be considerably more than a 'scientific bed-book', although it might sometimes well serve that purpose. Here, in fact, is a cross-section of twentieth-century activity, seen in sharply defined relief against its historical background.

F. I. G. RAWLINS.

PERIODICITY IN MALIGNANT GROWTHS

The Periodicity and Cause of Cancer, Leukaemia and Allied Tumours

with Chapters on their Treatment. By Dr. J. H. Douglas Webster. Pp. xv+178. (London: Baillière, Tindall and Cox, 1940.) 12*s.* 6*d.*

DR. WEBSTER'S main thesis is that malignant tumours do not grow continuously but show alternating periods of activity and quiescence. This behaviour is attributed to the nature of the life-cycle of the virus responsible for the disease. The full period for one part of the cycle is thirty-three weeks, but the great majority of cases show half periods and multiple periods.

In spite of the elasticity that is apparently allowable, it is very doubtful if Webster has established his main point. Naturally, interest centres around the evidence of periodicity to be found in untreated cases. Unfortunately in such cases we usually have to rely upon the account given by the patient. Thus, if a patient first notices a lump in January and says that it remained stationary in size until the middle of July, when it suddenly began to grow rapidly, then the period January–July represents a full period of quiescence. Those of us who have actually measured tumours over considerable periods may perhaps be forgiven the belief that the apparent discontinuity in the behaviour of the tumour is very likely an expression of psychology rather than of tumour growth.

Bashford is quoted as having been the first to establish experimental evidence of periodicity in tumour growth. The rhythms observed by Bashford and his colleagues were expressed in terms of the percentage of successful inoculations. Unfortunately this evidence, even if it were germane, would have to be discounted, since modern genetic experiments have shown that these rhythms are artefacts. This statement cannot be fully discussed here; nobody has brought any serious criticism against the genetic evidence, although it must be admitted that several people choose to ignore it. In general it may be stated that experimental work lends no support to the idea that malignant growth is fundamentally rhythmic in character. It is possible that rats and mice do not live long enough for the rhythm to be shown, but this argument loses force when applied to the rabbit, an animal in which virus-induced tumours have been observed over considerable periods without elucidating any fundamental rhythmic pattern.

As further evidence in support of his main thesis, Webster quotes several instances in which the time of recurrence was successfully predicted in cases undergoing treatment. Here it is not necessary to make any assumption concerning the nature of malignant growth; all that need be assumed is that the growth-rates of tumours are fairly closely grouped about a mean value.

Whilst few would deny that malignant growths may sometimes show surprising periods of quiescence or sudden changes in growth-rate, evidence that alternating periods of growth and quiescence should be regarded as the normal sequence independent of any treatment is still lacking. It is, of course, possible that variations in a virus may be responsible for some of the more obscure points in the behaviour of malignant cells. Up to the present, evidence on this point comes entirely from the laboratory. The data supplied by the clinician cannot as yet be said to have added anything of value.

P. A. GORER.

COCONUT DISEASES

The Diseases of the Coconut Palm
By Prof. H. R. Briton-Jones. Revised by Prof. Ernest Entwistle Cheesman. Pp. xvi+176+37 plates. (London: Baillière, Tindall and Cox, 1940.) 10*s.* 6*d.*

TO those who worked in close contact with the late Prof. H. R. Briton-Jones, professor of mycology in the Imperial College of Tropical Agriculture, Trinidad, the keen interest which he invariably displayed in attempting to make scientific investigations of direct use to the planter, and his sympathy towards the practical and economic difficulties by which the tropical agriculturist is so frequently beset, are common knowledge. This attitude is implicit in the work now under review. Its object, clearly stated in the preface, is ". . . to give those growers who have not had the advantage of a scientific training, and those agricultural officers who, through pressure of work in other directions or lack of library facilities, are unable to keep up with modern scientific literature, an account of the diseases of the tall coconut palm in simple English, with, it is hoped, a sympathetic understanding of the practicable limits of labour intelligence and the monetary unit in crop production under tropical conditions". On this basis the book must be judged. It may be said at once that in respect of directness and simplicity of presentation and choice of illustration the author has succeeded in no small measure.

The approach is appropriate to the subject. The tall coconut palm, one of the major tropical crops, is widespread in its distribution. Its cultivation has been attempted over a wide range of conditions, often unfavourable, with concomitant disease incidence and financial loss. Not least, the size and nature of the plant render it one of the least suitable subjects for the study of physiological processes. Where these are related to pathological aspects the approach tends to be by inference and analogy rather than by direct experimental observation. The author of the present work has faced such difficulties courageously, and, at the risk of laying himself open to criticism, has not hesitated to speculate freely on occasions where precise information has been scanty. The same attitude applies to the criticisms which are here and there made of the findings of other investigators.

The opening chapter refers to the bud rot complex, the analysis submitted doing much to clear the way for a straightforward exposition of the diseases described in subsequent chapters. The term 'bud rot', in fact, with one exception (*Phytophthora palmivora*), "is merely descriptive of a concomitant symptom of different kinds of diseases fatal to the coconut palm". Thereafter bronze leaf wilt, Phytophthora bud rot, tapering stem wilt, red ring disease, false wilt and lightning strike, stem-bleeding disease, root and leaf diseases, gumming disease and dropping of nuts, are dealt with in considerable detail, symptoms, environmental conditions, and relevant cultural practices being clearly indicated.

The account of bronze leaf wilt, attributed to drought in conjunction with unfavourable soil factors, is typical of difficulties arising in the study of this crop. In some instances the line between health and disease is very narrow; some affected plants may recover whereas others, in what appears to be approximately the same pathological condition, may succumb rapidly. Close and continuous observation is necessary in order that the slightly different symptoms may be correctly assessed. In a malady where anatomical investigation yields almost no symptoms of definite diagnostic value, such behaviour as that cited indicates clearly the difficulties and pitfalls that await the pathologist. Again, roots, though frequently abnormal and in a decayed condition, so far have only yielded a Diplodia species, an organism regarded as being only of secondary importance. Nevertheless, bronze leaf wilt ranks very definitely as a destructive disease, and, as the author's photographs and text plainly show, is one that may take a heavy toll of plantations of all ages. The account of this disease also directs attention to the fate that inevitably overtakes a crop the cultivation of which has been attempted under unfavourable environmental conditions.

The discussion of the several major diseases is on the same broad basis as that indicated for bronze leaf wilt. Where the author does not agree with the findings of other workers he has not hesitated to say so. In several such instances it is only too evident that our information regarding the physiological processes and reactions of such an unwieldy object as the coconut is quite inadequate, and that theory rather than fact will to some extent tend to hold the field until this defect is made good.

Lastly, in recommending this very readable book to planter and pathologist, reference should be made to the careful revision carried out by Prof. E. E. Cheesman and to the useful additions of recent literature incorporated by him, which bring the book quite up to date.

C. W. WARDLAW.

ASPECTS OF THE THEORY OF STATISTICS

(1) A Detailed Proof of the Chi-Square Test of Goodness to Fit.

By E. Russell Greenhood, Jr. (The Harvard Phi Beta Kappa Prize Essay for 1939.) Pp. xiii + 61. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1940.) 8*s*. net.

(2) Statistical Calculation for Beginners

By E. G. Chambers. Pp. viii + 110. (Cambridge: At the University Press, 1940.) 7*s*. 6*d*. net.

(3) Elements of Statistical Reasoning

By Prof. Alan E. Treloar. Pp. xi + 261. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1939.) 19*s*. 6*d*. net.

(4) Mathematics of Statistics

By John F. Kenney. Part 1. Pp. x + 248. 12*s*. 6*d*. net. Part 2. Pp. ix + 202. 11*s*. net. (London: Chapman and Hall, Ltd., 1940.)

STATISTICS is fast taking the place of mathematics as the matrix of the sciences. The individual is giving place to the aggregate, the point of location to the interval of confidence and the categorical assertion to the statement in probability. But as yet the subject has not reached that distinctive stage of development which is signalled by the appearance of a comprehensive and rigorous theoretical treatise; and it never will reach the stage at which a comprehensive account can be given of its practical applications in any work smaller than an encyclopædia. The result of these conditions has been the appearance, over the last few years, of an extensive crop of text-books dealing with more or less specialized aspects of the subject. Here is a sample of the harvest of 1939–40, not, on the whole, a vintage year.

(1) Mr. Greenhood's essay is an illustration of the need for a treatise on theory. Like many other students, Mr. Greenhood was presented with the chi-squared goodness of fit test and asked to take it on trust. Unlike many other students, he refused to do so. There being no readily available account of the mathematical and distributional theory on which the test is based, Mr. Greenhood attempted to worry one out for himself from the admittedly difficult papers in scientific journals. His interest in the subject survived this experience (which, in his own idiom, is something to say) and he produced the proof set out in this essay. He claims no originality for his work; but his treatment has at least an unusual piquant imagery, as instanced by his comparison of the contour lines of a bivariate normal surface to a family of concentric lopsided doughnuts.

It is appropriate enough that a member of Phi Beta Kappa should expound the mysteries of Chi, and as usual when Greek joins Greek, there is a great display of vigour and pertinacity. But it is not really necessary to take 61 pages to demonstrate the validity of the chi-squared test, and at eight shillings the book is much over-priced.

(2) Mr. Chambers' little book is an unpretentious attempt to explain how to perform the arithmetic of the common statistical processes, with special regard to the needs of students of the psychological and biological sciences. One opens it with hopes that the author has found some new ways of lightening the burden of arithmetical drudgery which weighs so heavily on the statistician, but in this respect the book is somewhat disappointing. Mr. Chambers has nothing to add to what already appears in published text-books. That being so, it is not evident to me for what class of reader the book is designed. Those who have the theoretical knowledge to use these arithmetical processes will have already encountered them in acquiring it; and those who have not the knowledge would do well to leave them alone.

(3) Prof. Treloar is concerned mainly with the fundamental concepts of statistical theory, and has endeavoured to deal with them in a systematic way unencumbered so far as possible by mathematical and arithmetical complications. The result is a very lucid and balanced book which will be read with profit by anyone who wishes to familiarize himself with statistical reasoning without spending too much time on analytical and computational details. It is somewhat elementary in scope—there is little, for example, about inverse probability, likelihood, fiducial limits, confidence belts and so forth; but Prof. Treloar hints at the possibility of a second volume on these topics. This is one of those books which bear the marks of experience in teaching the subject, and should have a general appeal.

(4) Mr. Kenney's two volumes are not so much a book as a compilation, and not a very good compilation at that. His first volume deals with the standard subjects of descriptive theory, frequency distributions, location, moments, dispersion, curve fitting and correlation; his second with probability, bivariate frequency, partial correlation, sampling theory, chi squared and statis-

tical inference. There are a number of examples, the best of which are taken from other authors.

The two volumes differ very much in the standard of mathematical knowledge required by the reader. In vol. 1 "no mathematics beyond the ordinary Freshman course in college algebra is required", although "a certain degree of mathematical maturity and intelligence is presupposed". One result of this is that Mr. Kenney finds it necessary in the chapter on curve fitting to prove over several pages such theorems as "If $y = f(x)$ is linear the rate of change of y with respect to x is a constant"—and this despite the fact that topics such as integration and interpolation have already been introduced. One would have thought that the mathematically mature mind would have accepted this result without proof and left Mr. Kenney space to include some really important material such as the method of fitting polynomials of degree greater than two. Vol. 2 is a little more advanced, but even this is only intended "to prepare the student for the really mathematical part of the theory of statistics". One cannot help wondering why Mr. Kenney called this book "The Mathematics of Statistics", unless it was on the *lucus a non lucendo* principle.

It is evident that a work of some 450 octavo pages cannot cover the whole field of statistical theory and that some selection of topics has to be exercised; but Mr. Kenney's principles of selection are difficult to grasp. There is a chapter on moments, but no word of moment-generating functions or semi-invariants. There are some pages on confidence intervals, but nothing on likelihood. The chi-squared distribution is derived in detail from the multinomial, but the simpler and equally important result that the normal curve is the limit of the binomial is stated without proof. In reciting the tests of significance of the correlation coefficient Mr. Kenney omits to give a reference to R. A. Fisher's classical paper on the distribution of the coefficient in normal samples, or to Miss David's tables of its probability integral, though several less important contributions are mentioned. He says that the most important Pearson curves are Type III and Type VII (the normal curve), mentions the trivial Type X, and ignores the three main types of the Pearsonian system.

Mr. Kenney's book is a step in the right direction and there are some good chapters, for example, on small sample theory; but most of the topics on which he touches require a more thorough treatment if their statistical and mathematical implications are to be properly grasped.

M. G. Kendall.

CULT AND CRAFTS IN EARLY PALESTINE

Lachish II (Tell-Ed-Duweir):
The Fosse Temple. By Olga Tufnell, Charles H. Inge and Lankester Harding. (The Wellcome-Marston Archæological Research Expedition to the Near East, Publications, Vol. 2.) Published for the Trustees of the late Sir Henry Wellcome. Pp. 104 + 73 plates. (London: Oxford University Press, 1940.) 25*s*. net.

TELL-ED-DUWEIR is the site of an ancient city, probably the Biblical 'Lachish', on the edge of the Judæan foothills, overlooking the Philistine lowland. It was excavated from 1932 to 1938 by the Wellcome-Marston Archæological Research Expedition to the Near East, of which the late Sir Robert Mond also was an early and generous supporter. The tragic death of the director, Mr. J. L. Starkey, and the political situation, suspended the work at a very interesting phase, and even the material now in London needs much further study; but the 'Fosse Temple', lying outside the city, had been completely explored, and is now published separately, in advance, on behalf of the Wellcome Trustees. It is a fine piece of work, a worthy memorial of the able leader of the expedition—of whom there is a characteristic likeness on p. 7—and testimony to the skill, zeal, and team-work of his helpers.

Though Lachish had a long and troubled history, as one of the chief Amorite centres in Palestine, the 'Fosse Temple' only covers a few centuries of it; but they were a period of historic importance As a strong place in Hyksos occupation, Lachish had been surrounded with the rampart and fosse characteristic of its masters. With their withdrawal before the forces of Eighteenth Dynasty Egypt, this great fortress fell into disrepair; and while the Egyptian governor and garrison occupied the top of the hill, a short section of the partly silted ditch was assigned to a sanctuary, of which the furniture and ritual was Palestinian, presenting many points of comparison with the ceremonial prescriptions of *Leviticus*. It attracted, however, dedications from afar; objects of Egyptian, Syrian, and Cypriot fabrics and styles, and even a few vases of Ægean make. A fine commemorative 'lion-hunt' scarab of Amenhotep III (1411–1375 B.C.: Pl. XXXII B. 39) must have been a royal gift, and a scaraboid of his queen Tiy (Pl. XXXII B. 2) was found on the floor of 'Structure II'. For, even in its short period, the 'Fosse Temple' was twice rebuilt, and on each occasion considerably enlarged.

Nothing datable was found earlier than Thothmes III (1501–1447 B.C.) or later than Rameses II (1292–1225 B.C.), and there is ample evidence that the temple was burnt in the period of invasion and disorder in the years after 1200 B.C. The strew of vessels, bones from sacrificial animals, and other objects on the floor aud benches of 'Structure III' suggests to the excavators (p. 27) that a ceremony was in progress when the building caught fire and collapsed. But no members of that congregation perished there.

Though doubtless other parts of the site will reveal more, the contents of the 'Fosse Temple' give a vivid glimpse of the material culture of its votaries, which in many respects was high. Special attention may be called to the toilet-vessels of variegated glass, the shapely stone jugs and bowls, the beads and rich pectoral collars in glazed paste, the engraved cylinder-seals of various Syrian styles, and the wide range of pottery types, which, as usual, offer suggestive synchronisms with other Palestinian sites.

Public attention was early attracted to the two painted inscriptions on vases, in a rough approximation to the script eventually standardized in Phœnicia. Here there is a careful summary of the divergent views of experts, and some constructive criticism (Ch. iv): an amusing 'warning to epigraphists' (p. 93) is supplied by a peasant's letter to one of the excavators, actually in English and in our alphabet, but uncomfortably like the writing on the 'Duweir Ewer'. Was the spelling of the Duweir scribe as good as his script ?

Few recent memoirs in archæology have been so carefully edited and published so handsomely—or so cheaply. The photography is admirable, and the coloured plates exceptionally pleasing. Besides group-registers and inventories of the finds, there is a very useful list of the biblical passages which the 'Fosse Temple' and its equipment illustrate.

JOHN L. MYRES.

YEAST PRODUCTION

The Manufacture of Compressed Yeast

By F. G. Walter. Pp. viii+254+3 plates. (London: Chapman and Hall, Ltd., 1940.) 15s. net.

ALTHOUGH leavening agents have been known since the days of ancient Rome, it remained for Louis Pasteur to analyse their nature and to demonstrate the practical potentialities of the common yeasts. Now, in the course of a few years, as Mr. F. G. Walter tells us, the manufacture of compressed yeast has evolved from obscurity to an industry of not inconsiderable importance. The work under review has been written from the strictly technical point of view and provides an unusually readable account of the carefully controlled processes which go to the successful large-scale production of this commodity. The author's treatment is comprehensive, and affords a full explanation of the guiding principles involved at each stage of the process.

To the general biological reader the book should also prove of considerable interest in that it shows how carefully ascertained facts as to the optimum conditions for the growth of the yeast organism have been applied on a commercial scale so that maximum yields may be obtained. This, indeed, is a fascinating aspect of the subject, and one which has been handled with commendable clarity. The opening chapter deals, in sufficient detail for technical purposes, with the several species of Saccharomyces and with the undesirable pseudo-yeasts, moulds and bacteria which may vitiate pure cultures. The author then passes on to the isolation of yeasts in pure culture, the production of seed yeast, the preparation of wort, the differential fermentation of a grain brew (that is, non-alcoholic fermentation of this material so as to provide the growing yeast with a uniform concentration of nourishment), yeast production from molasses and from spirit fermentations. In each instance, full instructions are given as to the method of handling the raw materials, the timing of the process during its several phases, and the precise nature of the supervision that must be maintained.

The two concluding chapters are devoted to the preparation of dried yeast and yeast foods and to the organization and equipment of the yeast factory. In the latter, not the least important unit is the laboratory. To its equipment and to the methods of analyses to be followed the author has made appropriate references. In conclusion, the book is one which can be recommended to the general biological reader for its interest and to the technician engaged in compressed yeast production for its utility.

Pomatoceros, Sabella and Amphitrite

By Joan G. Thomas. (Department of Oceanography, University of Liverpool: L.M.B.C. Memoirs on Typical British Marine Plants and Animals, 33.) Pp. vii+88+11 plates. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd., 1940.) 10*s.* 6*d.* net.

THE Liverpool Marine Biological Committee's memoirs have proved of great service to biologists and a new volume is assured of a welcome. Vol. 33 deals with three tubicolous Polychæte worms, illustrating progressive degrees of adaptation to the sedentary habit. *Amphitrite johnstoni* lies hidden under rocky clefts and stones, where it makes a temporary burrow in the sand. *Sabella pavonina* stands upright in the mud and constructs a neat tube of selected and agglutinated mud particles lined by a smooth glistening secretion like flexible porcelain. *Pomatoceros triqueter* forms a rigid tube of calcareous matter, fixed to a rock and decumbent, the animal lying on its back within the tube. The last species is of importance to the general worker because it is used for artificial fertilization, its trochophore larva being easy to rear under laboratory conditions. Miss Thomas rightly makes it her main subject for investigation.

The anatomy, histology and physiology of the three worms have been described, and the author compares their adaptations to the tubicolous habit. Much of this has been well done and the figures are clear. There is, however, no drawing of a whole worm or even of a complete branchial crown, and the general reader who does not know the worms well can obtain little idea of their appearance. The account of Sabella is largely taken from Dr. Nicol's paper, and does not, unfortunately, do justice either to Sabella or to Dr. Nicol. Perhaps the very excellence of Miss Nicol's work made it difficult to find anything new, but this is no justification for mistakes in anatomy, such as occur in Fig. 30 with regard to the ciliated fæcal groove. In describing Pomatoceros Miss Thomas does not mention the obvious fact that the operculum has a conical calcareous top, and she omits this top from Fig. 5. Did she prepare this figure from a specimen fixed in an acid mixture? If so, why? A calcareous operculum is one of the generic characters of Pomatoceros. May we stress once more the importance of accuracy in anatomical detail as the fundamental requirement for physiological work?

Living Mathematics:

a First Year College Course. By Prof. Ralph S. Underwood and Prof. Fred W. Sparks. Pp. ix+365. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 20*s.*

THE title of this book is a misnomer. It ought to be "Lively Mathematical Writing". Witness the following extract from the authors' treatment of the method of *reductio ad absurdum*: "Having hatched up a premise which collided mathematically with its conclusions, we can announce with confidence the eternal falsity of the premise and thus get a neat headlock on reality from the rear."

Stripped of such purple patches, the journalese cross-headings, and the historical references, we are left with a text-book covering in sound fashion all the work up to Intermediate B.Sc. standard—algebra, trigonometry, co-ordinate geometry, and calculus. In addition, there is a slight treatment of elementary probability and a little elementary theory of numbers. The presentation throughout reflects the experience and enthusiasm of good teachers. There is a wealth of interesting examples, which to the more staid and restrained English teacher will more than compensate for the touches of flippancy that recur throughout the text. The book is well printed on excellent paper and the diagrams finely executed, but the result is that the price is too high for the average British first-year student.

An Introduction to the Principles and Practice of Homœopathy

By Dr. Charles E. Wheeler. Second edition. Pp. viii+344. (London: William Heinemann (Medical Books), Ltd., 1940.) 15*s.* net.

IN the second edition of this work, of which the first appeared twenty-one years ago, Dr. Charles E. Wheeler, consultant physician to the London Homœopathic Hospital and past president of the British Homœopathic Society, has received the collaboration of two other physicians to the hospital, Drs. J. Douglas Kenyon and Francis H. Bodman. The work is divided into two unequal parts. The first and smaller part, which contains four chapters, is devoted respectively to general considerations, the structure of the homœopathic materia medica, homœopathic pharmacy, potentization and dosage, and the choice and mode of administration of the remedy. The second part deals in alphabetical order with thirty-two of the drugs most frequently used in homœopathic medicine.

The work may be recommended as a useful handbook to all seeking information on the subject of homœopathy.

Naturalist Errant

Out with Romany Once More

By G. Bramwell Evens. Pp. vii+168+8 plates. (London: University of London Press, Ltd., 1940.) 5*s.* net.

MR. G. Bramwell Evens ('Romany' of the B.B.C.) not only possesses the eye of the born naturalist, which makes every detail of a ramble in the country significant, but he also evidently knows, *par excellence*, how to pick his territory; and what is more, he knows how to impart his knowledge without incurring the danger of being considered pedagogic. As we read through the chapters of this pleasant book we are, in fact, caught up in the rambles by coppice and moor, by river and rocky dell, and, almost at first hand, we make the acquaintance of merlin, raven and buzzard, stickleback and badger, heron and woodcock, and many others, the places they live in, the food they live on. It is good, racy, direct observation, packed with interest, not lacking in its philosophy, but without sentimentality. The book is attractively illustrated by line drawings and by a number of good photographs.

Biological Aspects of Infectious Disease

By Dr. F. M. Burnet. Pp. xi+310. (Cambridge: At the University Press, 1940.) 15*s.* net.

THE aim of this thoughtful, but by no means readable, work by the assistant director of the Walter and Eliza Hall Institute of Melbourne is, as we learn from the preface, to discuss the subject of infectious disease from the point of view of the biologist rather than that of the medical practitioner.

The book is divided into six parts. In the first, which is devoted to biological considerations, the ecological point of view and the evolution of infection and defence are discussed. The second part deals with "Aggressors", by which bacilli, protozoa and viruses are to be understood. In the third part the processes of defence, that is, the various aspects of immunity, are considered. The natural history of infectious disease, which includes the mode of transfer of infection, the general character of epidemics, and prevalence of infectious disease, the age incidence of infectious disease, and the general principles of their control, form the subject of the fourth part. In the fifth part certain important infectious diseases, namely, diphtheria, influenza, tuberculosis, plague, cholera and malaria receive attention. The epilogue, which forms the sixth part, contains a brief account of certain new diseases and a somewhat vague outlook for the future. It is to be regretted that the book, of which, according to the preface, the manuscript was finished by 1938, was not brought up to date "owing to the circumstances of the present time", and that there is no bibliography and only a scanty index.

Mythology of the Soul:

a Research into the Unconscious from Schizophrenic Dreams and Drawings. By H. G. Baynes. Pp. xii+939+42 plates. (London: Baillière, Tindall and Cox, 1940.) 32*s.* 6*d.*

DESPITE its sub-heading, the title of this volume is somewhat ambiguous. It might mean mythology about the soul, or mythology that is created by the soul. This is unfortunate; for a book is not seldom judged by its title. One has, however, only to open it and read through a few pages to see what its author means. Dr. Baynes is occupied with the kind of phantasy that occurs when "before the human mind had ever set itself to the labour of thought, the myth already flowed like a natural fountain out of the unconscious". These are the opening words of his introduction, and they strike the key-note of what follows.

Since Dr. Baynes is an enthusiastic follower of Jung, who broke away from the school of Sigmund Freud some time before 1914, we should expect much use to be made of the concept of the activation, in pathological conditions, of archaic contents of the "collective unconscious"; and so we do. Apart from copious quotations, particularly from the works of Jung, and a large and varied range of mythological erudition, the book consists of an account of the psycho-analytical investigation of two cases only, and is illustrated by drawings, some of them coloured, of their dreams and phantasies. In this respect it reminds one of a work by G. R. Heyer ("The Organism of the Mind") published in its English form in 1933. Dr. Baynes writes with approval of Jung's "psychological types", that is, the distinction made by him between the "introvert" and the "extrovert", later expanded by Jung himself into varieties and cross-classifications of these two basic divisions. But the whole question of "types" is at present under discussion, and has encountered violent criticism.

We have this idea cropping up in one form or another since the classifications into "temperamental types" by Hippocrates and Galen, down to the "psychological types" of Jung himself, Jaensch, Dilthey, Spranger, Klages, Gross and Kretschmer, to mention only some. But these are due to clinical observation; not all their authors are agreed in respect of the "types"; and no adequate statistical procedures have been applied (as they have in other branches of psychology) in order to establish them and verify them. This manner of treatment may suffice for the arts of medicine and psychotherapy; but it is not scientific. For the rest, Dr. Baynes's "Mythology of the Soul" makes interesting and picturesque reading, interspersed as it is with similes, metaphors, and (though sometimes rather far-fetched) analogical arguments.

Philips' Chart of the Stars

Edited by E. O. Tancock. 46 in. × 36 in. (London: George Philip and Son, Ltd., 1940.) 3*s.* net.

IN this chart the whole sky is shown on a large sheet in three sections—one equatorial, Mercator projection, and two polar maps. The stars, which are graded in size according to magnitude, including the fifth, are shown as white circles on a blue background. The chart also contains a number of the more important clusters, nebulæ and variable stars, visible to the naked eye, or in field-glasses or small telescopes, and tables supply useful information on these. Many notes are added which explain the movements of the sun, moon and stars, and also clarify certain phenomena which are illustrated in the chart. Students will find this a useful guide to the heavens.

Electrolytic Condensers

Their Properties, Design, and Practical Uses. By Philip R. Coursey. Second edition, revised. Pp. xii+190+8 plates. (London: Chapman and Hall, Ltd., 1939.) 10*s.* 6*d.* net.

THE fact that a second edition of this book had to be prepared after a relatively short time indicates its usefulness. The new edition has been slightly enlarged, the additions being distributed more or less evenly throughout the book with an emphasis on the last chapter dealing with the applications of electrolytic condensers. The preferential treatment of this chapter (increased in length by 25 per cent), especially the information given on surge-proof condensers, will be welcomed by all users of this type of condenser.

SOME RECENT ADVANCES IN DAIRY SCIENCE*

By Prof. H. D. Kay, O.B.E.
National Institute for Research in Dairying, Shinfield

Keeping Quality of Milk

During the War of 1914–18, much milk was lost, when we could very ill afford to lose it, because of souring, and much milk that did not actually go sour was rejected because it tasted or smelt tainted.

As is now well known, premature souring is almost invariably due to bacterial decomposition resulting from faulty methods of production or handling. The milk industry, both producers and distributors, have learnt a great deal as to clean methods of handling milk since 1914, and an assessment of the situation during last summer has shown that in spite of the weather, which was very favourable to bacterial growth and to souring, the quantity of milk lost was much less than that reported during the summers of 1915–1918.

The reasons for this welcome advance during the last twenty years are: (*a*) producers have been trained in methods of producing clean milk; (*b*) more apparatus and equipment for cleansing and sterilizing milk utensils are available on the farm, together with better cow-sheds; (*c*) transport of milk from producer to country and town depots has improved both in organization and speed; (*d*) methods of measuring milk quality have improved; (*e*) there has been a large increase in the amount of milk properly heat-treated before distribution.

Research into practical production methods over some years has shown that the periodic steam sterilization of all utensils coming in contact with milk is the single factor which is most important in the production of milk of good keeping quality, flavour and pasteurizability. It is one of the requirements now called for in most counties before a producer of milk can become "accredited" and share in the bonus paid for each gallon he produces.

Another stipulation for accredited milk is that the milk shall pass the methylene blue reduction test. This test, though far from perfect, is a fairly simple one, which has been improved in recent years and enables a fair assessment to be made of the bacteriological quality of the milk at the time of testing, and hence of its probable keeping quality. This test depends on the fact that, in the absence of oxygen, the presence of bacteria in milk greatly accelerates the speed at which a solution of methylene blue added to the milk is reduced to methylene white. Good milk, well produced and handled, should not reduce the dyestuff for six or more hours, whereas poorly produced or dirty milk will reduce in an hour or two, and really dirty milk in minutes only.

A similar, but from the point of view of the cheese-maker a more valuable, test for milk quality is the resazurin-rennet test. This is a test of recent origin, similar in principle to the methylene blue test, but using a different reducible dye-stuff. Here, however, a little rennet is added to the fluid, so that in addition to testing the bacterial content of the milk, its coagulability, a property of first importance in cheese-making, and one which changes for the worse with certain types of poor-quality milk, may also be assessed.

Hygienic Quality

The original reason for heat treatment of milk was the purely commercial one of so improving the poor keeping quality of the raw product that it could be handled in bulk and distributed with the minimum losses from souring to consumers in localities remote from the areas of milk production. Without such heat treatment it would be practically impossible, except perhaps in winter, to provide adequate supplies of liquid milk to our largest towns.

Under existing official regulations in Great Britain, pasteurization consists essentially in the heating of milk at 145° F. for thirty minutes. It has been shown that heat treatment under these precise conditions not only destroys the bacteria which produce souring, but also kills any disease-producing organisms that may possibly be present as a result either of disease in the cow, such as tuberculosis of the udder, or subsequent infection of the milk from human sources. But the heating must be properly done, since for the most resistant of the pathogenic organisms which may be present—that of bovine tuberculosis—the margin of safety is only some 5° and 10–15 minutes.

If the temperature of the milk is raised above 145°, pathogenic organisms are destroyed progressively more quickly, until at 162° or above their life is only a second or two. Why not, it may be asked, for official pasteurization, have a really good margin of safety and heat at 162° for half an hour? The reason is that at these temperatures the cream-line is destroyed, that is, the milk fat will not separate on standing.

* *Continued from page 45.*

During the last few years, particularly in the Midlands, an increasing quantity of milk has been 'sterilized', that is, instead of being heated at relatively low temperatures, it is heated for some minutes under pressure and at temperatures above boiling point. The cream line is certainly destroyed, and the flavour is altered to one which can be described as slightly caramelized; but the great advantage is that the milk will keep for several days, or even a week or two. It is not actually sterile in the bacteriological sense; but there are usually only a few spores left, and certainly all the pathogenic organisms are destroyed.

Officially, the words 'pasteurized milk' can only be applied to milk which has been heated at 145° F. for 30 minutes, that is, holder pasteurization. An equally effective method of bacterial destruction is to heat milk to say 162° F. for fifteen seconds, which has an effect on the flora of the raw milk similar to that of the holder method, but which can be carried out in a smaller apparatus, with much less metal, much less room, and much less time. This quicker method has been thoroughly investigated, and with modern automatic apparatus for controlling temperature and flow to make sure that no particle of milk escapes without adequate heating, it is just as safe and reliable as the holder method. An advantage, particularly in war-time, is that pasteurized milk can be obtained within five minutes after beginning the operation, instead of forty-five minutes as with the holder process. Another advantage is that whereas in the holder process there is a tendency for certain heat-loving organisms to multiply in the pasteurization plant during the run to such an extent that the flavour of the milk may be affected, and processing has to be stopped while the plant is being cleaned, this does not occur in the high-temperature short-time (H.T.S.T.) process, temperatures of 160° F. or above being too high for the reproduction of the thermophilic organisms. These organisms which are in the milk before pasteurization are largely there as a result of inefficient cleansing and sterilization of the milk utensils used on the farm.

It is clear that with this small—though perhaps not really very small—margin of safety in either the holder or the H.T.S.T. process, it would be useful if some test could be applied to the milk itself to make sure that heating had been properly carried out. True, the pasteurized milk can be tested for surviving tubercle organisms by the very delicate guinea pig test, but this test takes six weeks to carry out, and in any case the original milk before heating may not have contained tubercle organisms. For many years a suitable test was sought, without success. Some seven or eight years ago it was observed that one of the enzymes present in all samples of raw milk, phosphatase, was destroyed over all ranges of time and temperature slightly *less* readily than the tubercle organisms, so that the destruction of the enzyme meant that these pathogenic organisms had been destroyed also, and that with a margin of safety. Delicate methods of determining the presence or absence of this enzyme in milk were worked out, and now the phosphatase test, as it is called, is a very sensitive and reliable method for determining whether a given sample of milk has, or has not, been heated under correct pasteurization conditions. It is equally effective with both holder pasteurized and H.T.S.T. pasteurized milk. The test is now so precise that it will indicate with certainty in the holder process a drop of 1·5° F. in the holding temperature or diminution of ten minutes only in holding time, or a leakage of as little as 0·2 per cent of raw milk into the pasteurized bulk.

EFFECT OF HEATING ON NUTRITIVE QUALITY

A question which has caused a surprising amount of controversy in past years has been the possible destructive effect of pasteurization on the nutritive quality of milk. The discovery of the vitamins, the fact that some of them are heat labile, and the fact that milk is a fairly good source of vitamins A and the B complex raised grave misgivings in some minds as to whether milk should be heated at all, or should be drunk in the *raw* state.

In the past five or six years the problem has been thoroughly investigated under the ægis of Lord Astor's Milk Nutrition Committee, and it has been shown very clearly that the effects of modern methods of commercial pasteurization are:—no change in vitamin A; only a small destruction, less than 20 per cent, in vitamin B_1; no change in lactoflavin (part of B_2 complex); some 20 per cent destruction of vitamin C (ascorbic acid). It has also been shown that the biological value of the proteins of milk, and also the nutritional availability of the calcium and phosphorus of the milk, are unaffected by pasteurization. In addition, extensive feeding trials on school children have failed to show any difference between raw and pasteurized milk in its effect on any measurable characteristic such as height, weight, clinical assessment, dynamometer pulls, etc. Similar results have been obtained with calves as the experimental animals.

The loss of vitamin C just mentioned is not entirely due to the pasteurization process *per se*: it has been shown at Shinfield that exposure of milk in a glass bottle to sunlight, or even to ordinary daylight for a few hours, will destroy the vitamin. The blue and violet end of the spectrum is mainly responsible. Ultra-violet would probably be active, but does not, of course, penetrate ordinary bottle glass. If, during the pasteurization process, the milk is not exposed to light, there is much less destruction of this vitamin.

From the point of view of human nutrition, it is doubtful whether this destruction of vitamin C is of real importance. Cow's milk is a poor source of vitamin C in any event, and if it is used for infant nutrition it ought to be supplemented by orange juice or some other good source of this vitamin.

Sterilization causes slightly greater changes in the nutritional value of the milk than does pasteurization. A small but definite lowering of the biological value of the proteins and an increased destruction of vitamin B_1 result from commercial sterilization. Sterilization has obvious advantages in giving milk of high keeping quality, but from the point of view of human nutrition, pasteurization is the preferable process.

EFFECT OF COW'S DIET ON MILK

The really important vitamin in milk is the fat-soluble vitamin A, and its precursor, carotene (β-carotene), also present in cow's milk, from which vitamin A is formed in the animal body. Both these constituents of milk vary considerably in amount from one part of the year to another, the carotene more than the true vitamin A. The importance of vitamin A in the diet of the young growing animal is due to the facts that it is a vitamin essential for growth, and that the new-born animal has very low reserves of vitamin A in its tissues. In relation to these low reserves, it has been found that colostrum, the secretion of the udder during the first three or four days after parturition, is at least ten times richer in vitamin A than true milk. Vitamin A is colourless, but carotene is a deep yellow pigment found in all green plants in association with the chlorophylls, and is responsible for the yellow colour of milk fat and butter. During the past few years it has been clearly shown that the total vitamin A potency (vitamin A + carotene) of a given volume of mixed milk from the same herd is greatest where the amount of green food being consumed is largest, that is, when the spring flush of grass has begun. Cows are able to store some of the vitamin A they make from the ingested carotene, in their livers and body fat, and even after they have gone on to the older type of winter diet (of roots, hay, etc., containing relatively little carotene), they still continue for a while to secrete vitamin A in their milk, but less and less carotene. Later the vitamin A falls off also, and with it a part of the nutritional value of the milk. With modern conditions of winter feeding, where good quality silage, or green fodder such as kale or cabbage, or possibly even dried grass, is fed, the vitamin A and carotene content of the milk is maintained during the winter months. That a good supply of vitamin A should be present in milk is indeed more necessary for human nutrition in winter than in spring, summer, and autumn, when other sources of vitamin A can be more readily obtained in the form of green vegetables, etc.

Another important vitamin in cow's milk is vitamin B_1, or thiamin. Though milk is not a rich source of vitamin B_1, it is a source important from the point of view of human nutrition, since the volume of milk consumed is considerable, and vitamin B_1 in milk is fairly stable.

It has not been found possible to control the concentration of B_1 in cow's milk by changes in the diet. This is because the cow herself is independent of exterior sources of vitamin B_1. She can synthesize, herself, probably with the aid of the very extensive population of micro-organisms present in her rumen, all the vitamin B_1 she requires for her own purposes, and for the milk she secretes. As a consequence the level of vitamin B_1 in the milk seems to be independent of the B_1 in the diet.

With the second important water-soluble vitamin of the B group—riboflavin—sometimes called vitamin B_2—there is a definite correspondence between the amount in the diet of the cow and the level in the milk. When the cows begin grazing in the spring, the level of riboflavin in the milk rises sharply to nearly twice its winter value. As with vitamin A, early colostrum contains much larger amounts of this factor than does ordinary milk.

The vitamin D content of cow's milk varies with the diet and with the extent to which the cow has been exposed to sunlight. If the diet contains vitamin D in appreciable quantities—though there are few of the normal constituents of a cow's diet which do—then the vitamin D level in the milk is raised. The feeding of irradiated yeast or cod-liver oil leads to an increase in the anti-rachitic potency of the milk, and it has been found that commercial cacao shell meal, which contains a little vitamin D, also brings about this effect.

Summer milk and also butter prepared from such milk may contain twice as much vitamin D potency as winter milk or winter butter from the same herd. The vitamin D content of early colostrum is three or four times that of normal cow's milk.

With relatively few exceptions, of which the vitamins just described are the most important, the quality of cow's milk remains largely unaffected by the diet. Where the food of the cow is ill-balanced or deficient in some material required for the milk, for example, calcium or phosphorus or protein, normal milk continues to be secreted for a while at the expense of the cow's tissues, and then, with possibly a little change for the worse in the composition, the daily volume secreted begins to fall off more or less rapidly, or stop completely.

To sum up, milk quality is affected by a large number of factors, many of which are now known and some of which are capable of control. The dietary factors and those connected with udder disease, for example, are under fairly good control. The changes in composition due to changes in hormonal balance are at present less controllable.

Milk secretion is known to take place in the cubicle cells lining the milk alveoli in the depths of the udder tissue. All the constituents appear to be secreted at the same time by these cells; there are no specialized cells yielding protein alone, or fat alone, or water alone. This being the case, control of composition ultimately means adequate knowledge and control of the secreting mechanism of the alveolar cubical cells, which means among other things knowledge and control of the amount and quality of the milk precursors reaching these cells from the blood stream, of their supplies of hormones, oxygen, fuel in the way of glucose or lactic acid, probably also of their cellular furniture—both internal structure and enzyme content.

EARLY WORK ON PERIODIC MOTION

By A. E. Bell,
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RECURRENT events hold an interest for the human mind through their appeal to a sense of order; in no other type of phenomenon is the insistent suggestion of law in Nature of a necessity which even "compels the gods" felt so forcibly. Certainly, from the empiricist point of view much might be made of the existence in Nature of manifold periodic recurrences, and the recognition of large- and small-scale rhythms has certainly played an important part in the origins of science. Pythagoras discovered the numerical key to the periodicities of musical notes and thus the abstract idea of periodicity entered mathematics (though the origin of this idea may lie far back with the Akkadian writers of about 2000 B.C. studied by Neugebauer). By the fifth century B.C. even the non-mathematical Aristotle looked on periodicity as almost the one sure indication of necessity in natural events: the only events of which absolute necessity could be predicated were those which formed part of a recurrent series such as the orbits of the heavenly bodies.

In scientific work, oscillations which are now described as simple harmonic dominate all others, at least in their historical significance. From Galilei's discovery of the isochronism of the simple pendulum through his (probably apocryphal) observation of the lamp swinging in Pisa cathedral we may trace the development of a line of thought which has been immensely valuable in modern science. In pure mathematics the study of simple harmonic motion elucidated the interesting properties of the cycloid, whilst, through the genius of Euler and Fourier, differential equations of great generality were discovered which embraced a wide range of phenomena. Fourier's theorem, expressed in geometrical terms, indicates, through its extension to many fields, the permeation of our analysis of Nature, in the last resort, by periodicity and by simple harmonic motion in particular. The history of science is interesting for precisely this reason: it supplies a scrutiny of the origins of modern thought.

The two great reasons for the virtual absence of developments in dynamics until the seventeenth century are the absence of accurate methods of time measurement, and the teleological character of Aristotelian thought which dominated natural philosophy for so many centuries. Benedetti (1530–1590) was among the foremost of those critics of Aristotle's mechanics who paved the way for Galilei, and it is noteworthy that he adduced a certain kind of periodic motion in a straight line as a proof of Aristotle's error in supposing that anything but discontinuous motion in a finite straight line was impossible. Obviously Benedetti's thought is here scholastic rather than modern. Elsewhere he pointed out that a weight falling through the centre of the earth would execute vibrations like those of a pendulum and would not, as was essential for Aristotle's system, come to rest at the centre.

But the first recorded statement of simple harmonic motion seems to be that of Copernicus. In his great "De Revolutionibus Orbium Coelestium" of 1543 he attributed oscillatory motions of this kind to the earth's polar axis in order to explain supposed fluctuations in the rate of precession and the obliquity of the ecliptic. Here he derived linear simple harmonic motion from circular motions projected on to an axis. The term simple harmonic came later; to Copernicus such motions were *pendentibus similes.*

So early a reference to the oscillations of a pendulum as a characteristic form of motion is remarkable, for it is uniformly held that Galilei first discovered the important property of the pendulum. Favaro says Galilei noticed the isochronism of pendulum oscillations a little after 1581 and certainly before 1589. Unfortunately there is no evidence that Copernicus really forestalled Galilei, for it is uncertain that he knew that the period is (approximately) independent of the amplitude. Nor is it possible to ascribe this discovery to da Vinci. The latter made a sketch of a pendulum clock not later than 1494, but the record is very indistinct and one can infer very little from it.

A more interesting question is whether Galilei, while making the discovery, realized the errors of the simple pendulum as a method of time measure. The records of the Accademie del Cimento say that Galilei knew of the inequality of small and large swings, but he himself did not refer to it. Mersenne stated that Galilei missed the observation and regretted that he had not been "more exact in his trials". In view of the fertile ideas Galilei based on his knowledge of the pendulum, however, Mersenne's regrets appear now to have been out of place, for an exact relation between the amplitude and the period could only have been a hindrance at that stage. Galilei was able, as it was, to relate the descent of a pendulum bob with descent over inclined planes which are chords of the same circle, to indicate a method of studying fluid resistance later adopted by Newton, and to point out the problem of the centre of oscillation later propounded by Mersenne and solved by Huygens. The simple pendulum also gave him a disproof of the idea of perpetual motion and a clue to the phenomenon of sympathetic vibrations in stretched strings.

In view of all this, there is little room for regret that Galilei's trials were only approximate. Enough is known of his experimental habits to be sure that he idealized the pendulum and probably intentionally ignored small experimental deviations from formulated laws of Nature, laws which Galilei felt convinced were characterized by their simplicity. All early experiments were to some extent vitiated by the vibration of the supports or of the suspending thread. Through placing two pendulum clocks in mechanical contact Huygens discovered the effect of resonance between the pendulums, and Ellicott made similar observations independently. What is more remarkable is that Viviani, a leading spirit in the Accademie del Cimento, is credited with the statement that all pendulums deviated slowly in the same direction[1] from their original planes of oscillation. On the strength of this, Antinori and Bertrand raised the question[2] whether in fact the Italian academicians discovered and understood the Foucault effect in the seventeenth century. Bertrand implied that this was so, but that fear of the Inquisition stopped their mouths—an intriguing idea but sadly lacking in evidence.

Hooke contributed work of great importance to this somewhat neglected subject of simple harmonic motion by his statement of the essential conditions of such motions. His well-known law *ut tensio sic vis* for the extension of elastic materials indicated even to his curiously non-mathematical mind the conditions of isochronous vibrations. He saw that the fundamental condition was the proportionality of the restoring force to the displacement. On the subject of the tautochrone his theory, though far from clear, showed the force on the bob of the pendulum at any point in its path as proportional to the slope of the tangent at that point (here following Jordanus's ideas on the inclined plane). If the slope is simply proportional to the height of the point above the lowest point this amounts to a definition of simple harmonic motion. Huygens informed the Royal Society what they could not prove for themselves, that the requisite curve was the cycloid.

It appears that Huygens made his discovery in trying to obtain an expression for the period of a very small oscillation of a simple pendulum. Galilei knew the relation between the period and the length of the thread but ignored or did not know the variation with amplitude. Huygens had little difficulty in the preliminary stages. Before December 1659 he was persuaded that Galilei's theorem concerning the identity of speeds acquired in free descent over inclined planes of equal height should be applied to certain curved surfaces also. By treating a small circular arc as approximating to a parabola (with the lowest points coinciding) he showed the isochronism of small vibrations of the circular pendulum. It was only through his intimate knowledge of the properties of the cycloid that Huygens was led to recognize that oscillations in such a path under gravity would be truly isochronous; and the proof of this property of the cycloid by classical geometry was no easy matter. When he finally published his work Huygens apologized that the proof was not as rigorous as Archimedes would have desired. The proof given later (1697) by John Bernoulli to show that the tautochrone was also the curve of quickest descent was carried out by means of the calculus.

The geometrical study of the periodic motions of bodies has, however, since the time of Newton, failed to give complete satisfaction. Whether in the case of the orbits of the planets or of electrons the demand for an explanatory mechanism in terms of force and energy has been irresistible. This has meant the isolation of systems to which the conservation laws may be applied. Newton took the important step of relating accelerated motion with forces, the operation of which remained obscure, and from the work of Huygens we may trace the restricted law of conservation of energy within mechanical systems given explicitly by Lagrange[3]. When, however, we reflect on the value of this successful reduction of periodic motions to laws, we find that the gain is purely one of mathematical expression. The concept of potential energy which must be dragged in, for example, has mathematical significance but we can form no useful picture of it and indeed the 'picturability' is irrelevant. The achievement of classical dynamics was the elucidation of mathematical relationships of increasing generality between *relata* whose properties are defined by such relations. No better contrast of the attitudes of thinkers to scientific laws could be found than that of Maupertuis and Lagrange to the principle of least action. For the former, who really originated the principle, the validity of the idea afforded insight to the nature of God Himself. For the latter the principle was a purely mathematical regularity of great use in the solution of dynamical problems.

General principles were indeed essential when physicists took up the problem of the propagation of oscillatory motion in waves. Newton tried to simplify the problem of wave motion by assuming that individual particles oscillated vertically in a way comparable with water in the limbs of a U-tube, but his method of tackling longitudinal wave motion was criticized by Lagrange, who showed that Newton erred in supposing that the vibrations in the shortest path were necessarily simple harmonic. Newton proved, however, what Huygens seems to have assumed, that the velocity of propagation of longitudinal vibrations through an elastic medium was determined by the ratio of the square root of the elasticity to that of the density of the medium. Transverse vibrations, despite Newton's U-tube analogy, with one exception, never occupied the attention of the seventeenth century men of science so far as is known. The exception was the work of Brook Taylor on vibrating strings. It was not until later, however, that the theory of surface undulations was seen to have close contact with that of stationary vibrations in strings. In the eighteenth century Euler and in the nineteenth Fresnel developed the wave theory of light on the idea of transverse vibrations first suggested by Young in a letter to Arago. It is interesting that in a later letter Young harked back to Newton's idea that the law of the undulations was that of a cycloidal pendulum "which is the simplest [assumption] possible". But Fresnel rightly has the greatest honour for the development of the wave theory and also for having "impressed natural philosophers with the importance of studying the laws of regular vibratory motion and the phenomenon of periodicity in the most general manner" (Merz).

In the nineteenth century many elegant applications of simple harmonic motion were made. The invention of the Kater pendulum, Foucault's famous experiment and the work of Coulomb, Gauss and others come to mind. The study of torsion in wires was particularly useful because the torsion balance which resulted became essential in many branches of experimental work—notably in investigating the laws of magnetic and electrostatic force. Coulomb also applied the torsional pendulum to study the friction of fluids against solids.

It was, however, in the theoretical developments associated with the propagation of electromagnetic disturbances that simple harmonic motion was so important in the nineteenth century; and from Maxwell's work to the present day the concept of periodicity maintains its importance independent of the rise and fall of particular physical theories. Yet, at root, our measurement of time and our ability to recognize equal intervals appear to rest on a purely subjective sense of time's flow. Time and space as perceived are incommensurable, but are brought into relation through the geometries of four-dimensional continua; our distinction of these separate aspects of the continuum is a psychological peculiarity. This makes the mathematical measurement of time appear altogether as problematical as it appeared before Huygens brought out his pendulum clock. For the time which we measure subjectively by the pendulum may have as much relation with the Riemannian continuum as our sense of space has. It is difficult to avoid the application of the categories of experience in a field where those categories are now abandoned. Nevertheless the time-dimension, although perhaps of different character from that of Galilei and Huygens, seems to hold an increasingly important position. The new geometry achieves what was an impossibility for Euclidean geometry: the incorporation of time. With that distinction, however, the substitution of geometrical laws for those of causation is in a sense a return to the pre-Newtonian era in which the laws of the universe appeared to be purely geometrical. Truly Plato's device again appears over the portals of science.

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[1] Cajori, "History of Physics", p. 150, footnote.

[2] Cf. Introduction to "Memoires sur le Pendule" of the Société Française de Physique, vol. 1.

[3] NATURE, 146, 511-14 (1940).

OBITUARIES

Edward Harold Hayes

EDWARD HAROLD HAYES, who died at Tref Elury, St. Asaph, on December 4, aged eighty-six, was an able and well-known teacher of mathematics in Oxford between 1878 and 1920. A son of the Rev. William Hayes, sometime vicar of Stockton Heath, he went to Eton in 1867 and was in a Dame's house, Miss Drury's, and a pupil of the Rev. F. St. John Thackeray. He went to Balliol in 1873 as a commoner, but after his first class in Mathematical Moderations and winning the Junior Mathematical Scholarship he wore a scholar's gown.

After first classes in Mathematical Finals and in Physics, Hayes was elected in 1878 a fellow and lecturer of New College, became a tutor in 1886 and senior tutor in 1901. He gave up teaching in 1920 but remained a fellow until 1934. After his retirement he lived first in Hertfordshire and then at St. Asaph.

Hayes was an excellent colleague both as a fellow and as an examiner, and he took an active part in the mathematical teaching of Oxford. His teaching was careful and methodical, and all his pupils were well taught and some achieved distinction. He regularly attended the meetings of the Mathematical Society and produced some elegant results. For some time he was secretary of the Association of Mathematical Lecturers, before the days of sub-faculties. As an examiner in the Schools of Mathematics and of Physics he took the utmost care in framing questions and in checking results and was a first-rate judge of men's work.

When he went to New College, there were only twelve resident fellows; he shared in its growth under Wardens Sewell and Spooner, and was an efficient and able member of the College staff, and liked by all his colleagues. He took an interest in all College business but shrank from University affairs apart from mathematics; thus in 1895 he declined to be nominated as proctor. He had married Isabella, daughter of T. M. Marriott and had a son and two daughters and was very happy in his married life. Hayes's good temper and sense of humour had won him good friends at Balliol, and his story of their advice when he went to be interviewed by the New College dons as a candidate for their fellowship is characteristic. "Say nothing against the Alps to Hereford George, or against the higher education of women to Alfred Robinson, but you may say anything that you like to Spooner." Spooner would have enjoyed that story.

When Hayes retired, his colleagues parted from him with affection and respect, as from one whose humour and good sense they knew they would miss for many a day.

Mr. Heywood Sumner

We regret to record the death of George Heywood Maunoir Sumner, artist and archæologist, which took place on December 21 at the age of eighty-seven.

Sumner was a 'local' archæologist of the best type. His accuracy as a field worker and his meticulous attention to detail in recording the results of his observation with pen and pencil has rarely, if ever, been surpassed. His activities were directed mainly to the study of Cranborne Chase, of which he appreciated to the full the natural advantages that had attracted the settlement of early man, and the New Forest, which he knew in intimate detail both as a centre of natural beauty and wild life, and as a storehouse of relics of early and simple forms of social life in Britain. His book on the "Ancient Earthworks of Cranborne Chase" (1913) was accompanied by fifty maps and plans, and has been regarded by competent critics as setting a new standard in accuracy and detail for the archæologist. The same qualities for which his work on Cranborne Chase was notable were also to be observed in his survey of the Wiltshire Grimsditch, of which he published a large-scale plan, correcting an erroneous description accepted for more than a century, and the survey of the British settlement of Gussage Cow Down, which covered an intricate and obscure area of more than a square mile.

While it would be going too far to say that Sumner's work reached a limited circle only, his preference for 'local' societies, such as the Hampshire Field Club, or the Bournemouth Natural Science Society, and his aversion from any form of self-advertisement, rendered his work less widely known than it should have been before the publication in 1917 of his "Earthworks of the New Forest", in which not only did he add fifteen new earthworks to the list of those already known, but also recorded his now famous discoveries of the kilns and pottery of the 'New Forest' ware of Roman age. Here Sumner's work marked a new departure, and stimulated an interest in the work of the local potter in Roman Britain which has proved eminently fruitful in archæological study.

Sumner's further publications were a guide book to the New Forest, which has been regarded as the best ever written, and "Local Papers, Archæological and Topographical, Hampshire: Dorset and Wiltshire", containing much local lore and valuable material of archæological interest.

We regret to announce the following deaths:

Mr. Eliot Howard, a well-known ornithologist and author of "The British Warblers" (1907–14), on December 26, aged sixty-seven.

Prof. Robert Howden, emeritus professor of anatomy in the University of Durham, aged eighty-four.

Prof. D. Robertson, professor of electrical engineering in the University of Bristol, on January 8, aged sixty-five.

Prof. J. H. Smith, formerly professor of engineering in the College of Technology, Belfast, on December 24.

NEWS AND VIEWS

Cultural Treaty between Greece and Great Britain

A CULTURAL convention, the first treaty of its kind to be concluded by Great Britain with any foreign power, has recently been signed by General Metaxas, Prime Minister of Greece, and Sir Michael Palairet, British Minister in Athens. Under the Convention, the Greek Government will provide every possible facility in the future for the British Council's work of making the English language and the British way of life and thought familiar throughout Greece. From the British point of view, the principal effect of the Convention is to give full scope for the British Council's activities in Greece.

The two most important provisions are as follows: (1) The British Council's Institutes of English Studies in Athens and the provinces are fully recognized by the Greek Government, who are sympathetically considering requests for expansion. The Council's immediate plans involve the opening of ten institutes in addition to those at Athens and Salonika, and five of these are now established. The same recognition is extended to the famous British School of Archæology, established in Athens since 1886. (2) The British Council is authorized to establish two primary schools and one secondary school for British subjects in Athens and a primary school in Corfu.

The other main provisions are: (1) Exchange of university staffs and men of learning; (2) facilities for the teaching of Greek and English in either country; (3) facilities for students in either country; (4) mutual recognition of degrees or diplomas taken by Greek and British subjects in either country; (5) British students in Greece to enjoy entire equality with Greek students as regards school and examination fees, and *vice versa* in the United Kingdom; (6) mutual facilities for the import to either country of printed matter. Special exemption from tax for books supplied to the Council's Institutes; (7) students' visits to Greece and the United Kingdom are encouraged and facilitated; (8) an Anglo-Hellenic Commission to be constituted in Athens and in London, to which matters of cultural co-operation may be submitted.

Flora of Town Ruins

THE extent of building sites damaged by air raids in London, Liverpool, Berlin and other cities in belligerent countries, many of which may not be occupied until after hostilities, affords an opportunity for the botanist to observe any correlation of the famous spread of *Sisymbrium irio* over the ruins of London after the Great Fire, a rapidity which earned it the popular name of "London rocket". That there will be such a colonization by plant species even in the centres of great cities is borne out by recent studies of the flora of inner London, Liverpool, Manchester and other towns; but this points more to a predominating success of *Epilobium angustifolium*, which was not a common British plant at the time of the Great Fire although it is now one of the most abundant weeds. Observations kept on the flora of building sites in London (*Selborne Soc. Mag.*, Oct. 1910; *J. Bot.*, 1911) showed that a building site cleared in Farringdon Street and left for two years before the War of 1914–18 produced twenty-eight flowering plants and ferns, one moss and one liverwort which established themselves, comprising widely distributed plants like *Epilobium angustifolium*, *Senecio vulgaris*, *Tussilago farfara*, etc., refuse weeds and forage or packing weeds.

Wild vegetation noted on a building site in the Strand, 1929, included *Epilobium angustifolium*, *Sisymbrium pannonicum* and *Erigeron canadense*; while a 1939 survey of the wild flora of the Liverpool Metropolitan Cathedral building site, by botanists of the Merseyside Naturalists' Association, revealed forty-three species, of which *Epilobium angustifolium* was the most noticeable, others in abundance including *Senecio viscosus*, *Matricaria inodora* and *Trifolium repens*. *Epilobium angustifolium* is introduced to town sites by wind distribution of its seeds, but many plants will be introduced by birds or from seed distribution with commerce and building materials, as has already occurred on the building sites of some public air raid shelters. In the *Journal of Botany*, 1940, Dr. Ramsbottom described the introduction of the beech wood fungus, *Peziza repanda*, in abundance to London in the soil, etc., in rotting sandbags used in A.R.P.

Flora of South Albania

THERE can be few areas in Europe about which less is known of the flora than southern Albania. Large areas in the south of the country have been either wholly untouched by collectors or visited on a single occasion often only for a single day. Having regard to the richness of the flora of the Balkan Peninsula, the whole area might well be expected to yield results of taxonomic and plant geographical importance. Two expeditions made by A. H. G. Alston and N. Y. Sandwith (*J. Bot.*, May–Oct. 1940) in 1933 and 1935 have shown that the limestone mountains of the area reproduce in the main the characteristic flora of the Greek Epirus and the Pindus, and the vegetation of the higher serpentine areas is similar to that of parts of central Albania.

More than two hundred species new to the country were collected and a few new species and varieties are described. Near Moscopole two well-marked endemic species *Arenaria serpentini* and *Brachypodium serpentini* were discovered. Some notable extensions of range of previously described species are also recorded. Among these may be cited *Stachys decumbens*, previously regarded as endemic in the

Ionian Islands, discovered near Santi Quaranta; *Crepis rutilans,* formerly only known from Corfu, found between Santi Quaranta and Valona; *Cicer Montbretii,* recorded only from Thrace; *Geum heterocarpum* and *Cynoglossum pustulatum,* both new to the Balkan Peninsula, the latter previously known only in southern Spain.

Recent Additions to British Mammals

THE recent discovery of a specimen of the squirrel-tailed or edible dormouse (*Glis glis*) in Shropshire, near Ludlow (*Field*, Jan. 4) is an interesting example of an alien mammal that has colonized parts of the British countryside. Although it is a controversial point with naturalists as to whether or not established aliens and feral escapes in the countryside should be admitted to the faunal list, some recorders do accept them when they are permanently established in the wild. Some fifty years ago, the late Lord Rothschild released specimens of the squirrel-tailed dormouse, a native of south Europe, near Tring, since when it has established itself in parts of Hertfordshire and Buckinghamshire and is increasing; but the Shropshire record is apparently farther north. There are small Japanese deer established in some woods in the Home counties and Lakeland, where they are often confused with roe deer, which also exist there, while an interesting example of feral animals establishing themselves are the herds of 'wild' goats that inhabit some of the mountains of Wales, as on Rhinog Fawr, near Llanbedr, where some of the old billies have huge horns; and also in Scotland, where at least thirteen wild herds were counted a few years ago at places like Ben Lomond, at Dochfour near Inverness, on the Black Isle cliffs near Cromarty, in western Ross, Mull, Islay, Harris, Tiree, Rum, Arran and Eig. There was once a herd of feral goats on Ailsa Craig, but they were shot down because they interfered with the tame goats kept by the lighthouse keepers.

British Woodlands

PROF. A. G. Tansley discusses natural and semi-natural British woodlands in a paper published in *Forestry* (14, 1; 1940). The native British woodlands have been so largely destroyed, and existing woods are now so extensively the results of planting and replanting, says Prof. Tansley, that foresters are naturally inclined to think of them all either as plantations, or as derelict and worthless wood and scrub, of value only as possible sites for new plantations. Some foresters will think that the accusation is correct; for many quite lose sight of the value and importance of a study of the historical part of a forest region or area which may have been once afforested. Prof. Tansley traces the progress of forest destruction in Britain from Neolithic times downwards to the present day. The island climate and the fact that Britain could always obtain all she required by imports removed from us the disabilities following severe deforestation in other parts of the world.

Briefly, Prof. Tansley's thesis is that for any given type of soil the old type of forest peculiar to the soil and locality will reappear, given a chance to do so. He believes that the old forest of, say, the south of England still persists in the many examples of coppice with standards, where oak is so commonly one of the chief species among the standards; and that with the exclusion of man and his flocks, and the rabbits and hares in excessive numbers, Nature would restore in time the same type of forest as originally existed over so large a part of the country. This claim can be substantiated by careful observation, not only in Great Britain but also in several tropical countries.

Supply and Price of Bread

AN important statement upon the supply and price of bread was made by the Minister of Food in the House of Lords on December 19; it was supplemented by the chairman of the Medical Research Council. Lord Woolton said that, although we are already spending £35,000,000 in subsidizing flour generally, an extra £750,000 is to be spent in three months (as from December 1, 1940) to keep the cost of all bread at 8*d*. or less for the 4 lb. loaf. He had further decided to adopt an 85 per cent extraction as a basis for wholemeal flour, which would be supplied at the same price as what was called "national straight run" white flour (70 per cent extraction). Synthetic vitamin B_1 will be added to the white flour, but supplies will probably not be available in any quantity until May. Lord Woolton is loth to force wholemeal bread upon the public for several reasons, one very important one being the failure of high-extraction flour to keep as well as white flour. But he has been impressed by the unaninimity of scientific opinion on the nutritive value of wholemeal bread, and therefore in the printed literature of the Ministry of Food he will continue to advocate its virtues.

Lord Balfour of Burleigh said that the Medical Research Council recommends that bread should be made of an extraction of the wheat grain of not less than 80–85 per cent, and that a small percentage of calcium salt should be added to the flour. Although wholemeal flour contains more calcium than white flour, it is more essential to add calcium to the former than to the latter—an apparent paradox which both he and Lord Woolton seem to find difficult to understand. The reason is that wholemeal flour contains more phytic acid than white flour, and this acid prevents the absorption of calcium from the intestine. Lord Balfour continued that there is evidence that calcium deficiency has long been a defect of nutrition among people in Great Britain. On one point only did he disagree with Lord Woolton: he (Lord Balfour) was told that high-extraction flour, properly made, would keep suitably. In reply, Lord Woolton said that he intended to continue in ignorance of what a vitamin is, to rely upon the men of science who give him their support, and to advise the public of the results of this scientific research.

Preliminary Training for the Flying Services

THE Secretary of State for Air has announced that it is proposed to establish an Air Training Corps to provide preliminary training for men desiring to enter the Flying Services. The scheme will be divided into three parts: units will be formed at the universities, at secondary schools, and locally. At the universities, the Air Ministry is arranging a six months course for potential pilots and navigators; candidates will join the university air squadrons for instruction in service subjects, and at the same time they will attend courses given by university lecturers on mathematics and mechanics, and on either electricity and magnetism, engineering, meteorology or navigation. They will be full members of the university, and will live in colleges and hostels so far as possible. All expenses, apart from certain personal items, will be paid for by the Air Ministry. Candidates must be between 17 years and 18 years 8 months on February 15 and will be selected on nomination by headmasters; the first course begins on April 15.

Local units, for which the organization of the Air Defence Cadet Corps will be used, will be formed, and the Air Ministry is providing for lectures arranged by local authorities on mathematics and English. For the schools scheme, boys should be between 16 and 18 years of age, and they will carry out a syllabus approximating to that of an initial training wing of the R.A.F., the principal subjects being navigation, mathematics, signals and the theory of flight. Financial assistance will be provided by the State.

Sir Henry Head's Bequest to the Royal Society

UNDER the terms of the will of the late Sir Henry Head, the Royal Society is named as residuary legatee, and it is believed that a substantial sum of money will go to the Society in due course. The broad terms of direction in the will are that the money "shall be applied for the purpose of the advancement in England of the science of medicine in the widest sense"; for this purpose a committee of not less than three or more than five is to be appointed to administer the fund. Without imposing any obligation on this committee, the will suggests that the fund, or part of it, might be used to establish professorships or similar posts or research scholarships in a branch of medical science at medical or other educational institutions. Sir Henry Head, who died on October 8 last, had been a fellow of the Royal Society since 1899, and was awarded a Royal Medal of the Society in 1908.

Reading Machine for Microfilm

THE Committee on Scientific Aids to Learning, which reports to the U.S. National Research Council, is promoting, among other things, the use of microfilm, and, as a result of its efforts, a reading machine is being manufactured which will be sold at a retail price of 32 dollars. A grant from the Committee has made it possible for *Mathematical Reviews* to obtain a limited number of these machines, which will be available to those who have paid their subscriptions, at the appropriate rate, to *Mathematical Reviews*, in advance for three years beginning this month. The history of the 'reader', known as the Students Microfilm Reader, goes back to the autumn of 1939. At that time an advisory group on microphotography to the Committee on Scientific Aids to Learning, composed of Mr. Keyes D. Metcalf, director of the Harvard University Library (chairman), Profs. Ralph D. Bennett and Ernest I. Huntress of Massachusetts Institute of Technology, Dr. Vernon D. Tate of the National Archives, and Dr. Irvin Stewart, director of the Committee on Scientific Aids to Learning (*ex officio*), was requested to consider the possibilities of designing and making available a simple, inexpensive microfilm reading machine for the use of the individual student.

Eventually the Spencer Lens Company was authorized to build a model, and the Committee on Scientific Aids to Learning has now signed a contract for a number of these machines; in addition, they will be placed on the market by the Spencer Lens Company. Emphasis has been placed throughout on suitability for the purpose for which the reader was designed, simplicity and low cost. No claims are made for extreme convenience, beauty, ready portability, or universality. The Students Microfilm Reader is not intended to compete with existing reader equipment, which is generally more suited for commercial and library use. It was developed specifically to permit the individual student to utilize in his own study or laboratory microphotographic copies which he may have made personally or procured from one of the existing sources of supply. The address of *Mathematical Reviews* is American Mathematical Society, Brown University, Providence, R.I.

Developments in B.B.C. Services

NEW programmes for France and Luxembourg and an additional bulletin in Polish are included in recent developments made in the B.B.C.'s European Service (*Practical Wireless*, Feb. 1941). A Sunday programme for French listeners entitled "Une demi heure du Dimanche" which is now broadcast during 3–3.30 p.m. B.S.T., includes a review of the week's events and talks on general interest and religious subjects. It is transmitted on the wave-lengths 49·59 metres and 25·29 metres. The new programme for Luxembourg is broadcast on the last day of the month between 8.0 and 8.15 p.m. B.S.T. in the period entitled "Radio Belgique". The wave-lengths on which this transmission may be received are 285·7 metres, 261·1 metres, 49·59 metres and 30·96 metres. A third news bulletin in Polish was recently added to the B.B.C.'s broadcasts in Europe and can be heard during 4.15–4.30 p.m. B.S.T. each day on 49·59 metres and 25·29 metres.

Mr. R. C. McCall, who has been appointed to the B.B.C. staff to organize the new Pacific transmission of the B.B.C.'s Overseas Service, has recently arrived in Great Britain. This provides a further example of the close co-operation between Dominion broadcasting organizations and the B.B.C. Another similar case has been the appointment of Mr. E. L. Bushnell, controller of programmes for the Canadian Broadcasting Corporation, to the position of North American programme organizer of the B.B.C. Overseas Service and the work in Great Britain of the Canadian Broadcasting unit.

Control of Lice

IN the *British Medical Journal* of November 2, Prof. P. A. Buxton contributes an article on this subject. The crowded sleeping conditions that prevail in some of the air-raid shelters render it likely that outbreaks of body and head lice will occur. In peacetime, at any rate, the body louse is much the rarer of the two races, but it is likely to become more prevalent. At the present time no really effective practical repellent is known. The control measures advised concern the head and body and the disinfestation of clothes, blankets, etc. The best methods for effecting these processes are discussed in some detail. For control on the person the speediest method for eliminating the head louse is the use of one or other of the insecticidal liquids advised. Disinfestation of garments, etc., is best done by the application of heat: 5 minutes at 129° F. or 45 minutes at 121° F. are fatal both to the lice and to their eggs or nests. It is not important whether the heat be dry or moist; but it is essential that the whole of the infested materials should be submitted to the temperature mentioned. Disinfestation of clothes properly done with a domestic hot iron is quite effective. The organization and proper lay-out of disinfesting stations does not lend itself to explanation in a short article, and the reader is referred to the "Army Manual of Hygiene" for information on this aspect of the problem.

Spread of Desertic Conditions

MUCH has been heard in recent years of soil erosion, due to a variety of causes, emanating usually in ill-advised use of the land. In Africa this has been shown to cause the spread of waste or desertic conditions. In a paper in the *Geographical Journal* of November, on desert versus forest in Eastern Africa, Mr. E. J. Wayland points out that there are climatic deserts and climatic forests and that each will retain its characteristics in spite of man's interference; man can do little to change the aspects of such lands. However, between the essential desert and the essential forest there is forest land which on its desert side is (or was, since in Africa most has been destroyed) a zone of forest-desert equilibrium, disturbable, to the desert's advantage, by Nature or by man. This is the zone of counter forest, and on the true forest side shows a marginal belt where the forest holds as long as natural conditions have sway. In this belt, however, man-made desert is not merely possible but is very general in Africa. All African forest areas with one or two long dry seasons and a rainfall of not more than 30 inches a year may be regarded as marginal in character, and all such areas are liable to soil erosion. Mr. Wayland does not believe that desert will or can spread into the essential forest: the counter forest acts as a buffer that holds in check the spread of the desert conditions.

Prof. Eduard Albert

PROF. EDUARD ALBERT, a pioneer of modern surgery in Austria, was born at Sznfterberg in Bohemia on January 20, 1841. He received his medical education at the University of Vienna, where he studied under Hyrtl, Skoda, Brücke, Oppolzer and Rokitansky. After qualifying in 1867 he became assistant to Prof. Johann Dumreicker, professor of surgery in the Vienna Faculty. In 1872 he was appointed professor of surgery at Innsbruck where he remained for eight years and then succeeded Dumreicher at Vienna. It was here that he gained a European reputation by his introduction of Listerian antisepsis, which Dumreicher had rejected, and attracted a number of students who afterwards became eminent surgeons. Albert was well known in Great Britain, where he was elected an honorary fellow of the Royal College of Surgeons in July 1900. His principal publications were "Diagnostik der chirurgischen Krankheiten", "Lehrbuch der Chirurgie" and "Beiträge zur Geschichte der Chirurgie". He died on September 20, 1900.

Albert King

ALBERT FREEMAN AFRICANUS KING, a pioneer in malariology, was born at Bicester, Oxfordshire, on January 18, 1841, the son of a doctor interested in the colonization of Africa. At the age of ten he migrated with his parents to the United States. He received his medical education at the National Medical College at Washington, where he graduated at the age of twenty, and four years later obtained the degree of M.D. at the University of Pennsylvania. He settled in practice in Washington, where he attended Abraham Lincoln at the time of his assassination in 1865. He was for many years professor of obstetrics in the George Washington University and in the University of Vermont, which latter institution conferred on him the degree of LL.D. in 1904. He was the author of a "Manual of Obstetrics", which went through eleven editions; but he is best known for a paper entitled "Insects and Disease—Mosquitoes and Malaria" read before the Philosophical Society of Washington on February 10, 1882, and published in the *Popular Science Monthly* in September 1883, in which he gave nineteen reasons for believing that malaria is transmitted by the mosquito. He died in 1914.

Announcements

THE following officers of the Royal Society of South Africa have recently been elected: *President*, L. Crawford; *Treasurer*, R. W. James; *Secretary*, A. J. H. Goodwin; *Editor*, Mrs. M. R. Levyns; *Librarian*, E. Newbery; *New Additional Members of Council*, G. Arnold, W. F. Barker, M. Rindl.

IT is hoped to hold the first meeting of the Colour Group of the Physical Society at the Polytechnic, Regent Street, London, W.1, at 2.0 p.m. on February 12. The first portion of the meeting will be devoted to a discussion of the draft constitution of the Group. During the second portion of the meeting four short papers will be read on "Colour Tolerance".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Structure of the Sterkfontein Ape

A LARGE monograph on the South African Australopithecines is being prepared, and is well advanced; but as it cannot possibly be published, at the earliest, for some months, it may be well to give a preliminary note on two points of interest.

Recently an important paper has been published, by A. J. E. Cave and R. Wheeler Haines[1], on the nasal sinuses of the great apes. They confirm the views previously expressed by Duckworth. In the gorilla, they show that there is a large bulbous dilatation of the nasal duct; while in the chimpanzee the maxillary antrum has an extension into the palate. In the Sterkfontein ape (Plesianthropus) the antrum differs from that of the gorilla in there being no bulbous dilatation of the nasal duct, and from that of the chimpanzee in there being no palatal extension. In these two characters Plesianthropus agrees with man. Fig. 1 is the front view of a natural cast of the antrum of the type specimen, and shows its relations to the second molar tooth. The antrum is bilobate to some extent, and the intraorbital nerve passed through a canal in its upper part.

Some time ago, I was fortunate in finding at Sterkfontein a perfectly preserved os magnum. Though nearly human, it seemed unduly small, and I thought of the possibility of its being the os magnum of a large baboon. At the time, I had no baboon carpus at hand for comparison, and in the stress of other work no further examination was made. On taking up the matter recently, I was forced to the conclusion that this must be the os magnum of Plesianthropus. It cannot be a baboon os magnum. Fig. 2 shows this bone, and for comparison the corresponding bones of a large male baboon, a large male chimpanzee, a large male gorilla, and a male and female pure Bushman. In structure the os magnum of the Sterkfontein ape comes nearest to that of man. It has no close resemblance to the corresponding bones of the baboon, chimpanzee or gorilla. If the identification is correct, then the Sterkfontein ape must have had a hand not larger than that of a Bushman woman, and quite unlike those of the chimpanzee and gorilla.

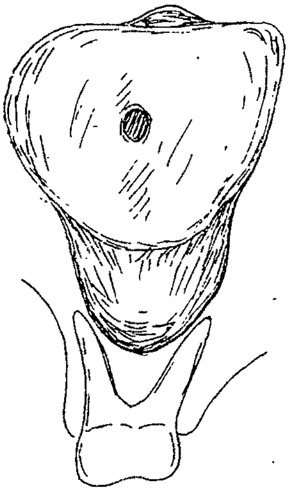

Fig. 1.

FRONT VIEW OF CAST OF THE RIGHT MAXILLARY ANTRUM OF *Plesianthropus transvaalensis*, SHOWING ITS RELATIONS TO THE 2ND MOLAR, AND THE POSITION OF THE INFRA-ORBITAL CANAL WHICH PASSES THROUGH THE ANTRUM.

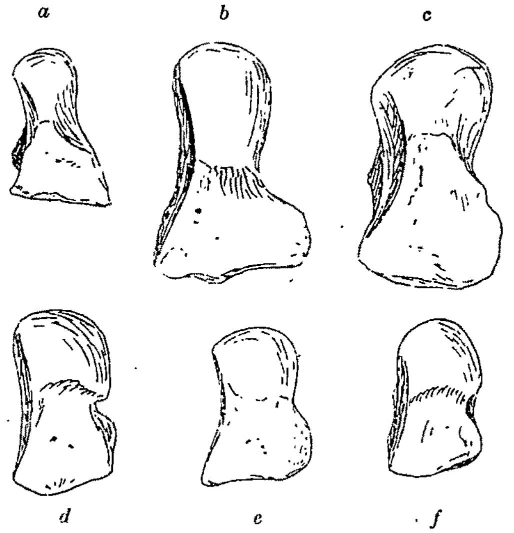

Fig. 2.

THE OS MAGNUM OF THE RIGHT CARPUS OF *Plesianthropus transvaalensis* AND OF OTHER PRIMATES FOR COMPARISON.

a Os magnum of large male baboon.
b ,, ,, of large male chimpanzee.
c ,, ,, of large male gorilla.
d ,, ,, of male Bushman.
e ,, ,, of *Plesianthropus transvaalensis*—probably female.
f ,, ,, of female Bushman.
All figures natural size.

The bone was from the same cave and from near the spot where the beautiful small female maxilla was found which I figured in NATURE of May 7, 1938. Not improbably some may argue that this small carpal bone is really human; but no other human remains have been found in the cave, nor even human implements. The maxilla has remarkably human teeth, and we need not be surprised if the being proves to have had a human hand.

If the bone belongs to the Sterkfontein ape—and I do not think there can be the slightest doubt on the matter—then we must conclude that this ape had a hand that was not much used for walking, and that Dart was probably correct in his conclusion, from the structure of the brain, that Australopithecus was mainly, if not entirely, bipedal, like man.

R. BROOM.

Transvaal Museum,
Pretoria.
Nov. 27

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[1] *J. Anat.*, 74, 493 (1940).

Rhizoctonia Rot of Swedes

IN the course of field experiments with dry rot of swedes caused by *Phoma lingam* (Tode) Desm., the presence of a different form of rot was observed on Magnificent and Tipperary purple topped swedes growing at East Craigs, Corstorphine. This rot was characterized by a slightly sunken, putty-coloured lesion, usually bearing closely spaced faint zone lines. It was readily distinguished from *Phoma lingam* rot by the absence of fructifications and the presence of a pink margin instead of a dark brown one. Such lesions were always associated with mechanical injury to the swede 'root'. The rot was comparatively shallow, dry, rather fibrous and yellowish-brown in colour.

Plentiful white mycelium grew over the surface of cut lesions when kept under a bell jar, but no fructifications were observed. Isolations from the diseased tissues consistently yielded a strain of *Rhizoctonia solani* Kühn indistinguishable in culture from those recovered from sclerotia on potato tubers.

The putty-coloured, pink bordered type of lesion was confined to the purple upper part of the 'root'. On the yellow part below soil level shallow, blackish-brown, roughly circular lesions were found from which the same fungus was isolated.

Inoculation experiments were carried out with three strains of *Rhizoctonia solani* on mature Tipperary swede 'roots' in the laboratory: (*a*) isolated from swede as above; (*b*) isolated from sclerotia on the surface of a Di Vernon potato tuber; (*c*) isolated from dead tissue below a bruise on a Golden Wonder potato tuber.

Strain (*a*) when inserted into cuts made with a sterile scalpel gave rise to rots identical with those observed in the field, namely, a zoned yellowish-brown lesion with pink margin on the upper parts of the 'root' and a blackish lesion with no distinctly coloured border on the yellow lower part. Pieces of agar culture of the same strain about ¼ in. square placed on the surface of uninjured 'roots' gave rise to no lesion.

Inoculations with strains (*b*) and (*c*) resulted in slight browning of the edges of the wound but caused no rot over a period of six weeks. Uninoculated cuts remained healthy.

About 1 per cent of the Tipperary 'roots' in the field were severely attacked by this disease.

Lauritzen[1] records a similar disease of turnips in Virginia. His strain of *R. solani* apparently differed from mine in its capacity for attacking uninjured roots.

Thomas[2] isolated four strains of Rhizoctonia from turnip in Holland, and Deighton[3] records *R. solani* attacking turnips in Sierra Leone. Hansen[4], in Norway, records infection by *R. solani* of swede seedlings in petri dishes, but I have been unable to trace any record of a swede rot in the field due to that fungus in the British Isles.

R. W. G. DENNIS.

Plant Pathology Service,
Seed Testing and Plant Registration Station,
East Craigs, Corstorphine,
Edinburgh, 12.
Dec. 16.

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[1] Lauritzen, J. I., *J. Agric. Res.*, **38**, 93–108 (1929).

[2] Thomas, K. S., "Onderzoekingen over Rhizoctonia", Thesis, Utrecht (1925).

[3] Deighton, F. C., *Ann. Rept. Agric. Dept. Sierra Leone*, 1930, 28–31 (1931).

[4] Hansen, H. P., *Nordisk Jordbrugsforsk.*, 191–200 (1932).

Nomenclature of Gas-Gangrene Toxins

IN NATURE of December 7, p. 748, there is a brief note on the report of the international inquiry into the assay of gas-gangrene antitoxin (perfringens)[1]. In this report, Prigge's[2] notation is used, in which the lethal factor is described as *zeta* toxin and the more hæmolytic factor as *alpha* toxin. The use of this notation is unfortunate and likely to lead to considerable confusion. The lethal factor called *zeta* toxin by Prigge is identical with that which Glenny and his co-workers[3] named *alpha* toxin in 1933, so that this usage had priority over that of Prigge by three years. During the interval, and since, a large literature has accumulated in which Glenny's nomenclature is used. It is therefore desirable to adhere to the English notation.

When in 1938 Ipsen, Sordelli and I undertook the international inquiry, it was our original intention to abide by the English method of notation, namely, to call the lethal factor *alpha* toxin and the more hæmolytic factor *theta* toxin, this last name being the one in use by Glenny for this factor in work still unpublished. For some reason unknown to me, Ipsen, who prepared our paper for publication, changed to the German notation at the last minute, and I was not aware of the change until after publication. Unfortunately, it has not been possible to communicate with Ipsen since publication, owing to the invasion of Denmark by Germany.

M. LLEWELLYN SMITH.

3 Eversley Road,
London, S.E.19.

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[1] Ipsen, J., Llewellyn Smith, M., and Sordelli,. A., *League of Nations. Bulletin of the Health Organisation*, **8**, 797 (1939).

[2] Prigge, R., *Z. Immunforsch.*, **89**. 477 (1936).

[3] Glenny, A. T., Barr, M., Llewellyn Jones, M., Dalling, T., and Ross, H. E., *J. Path. and Bact.*, **37**, 53 (1933).

Magnetic and Thermal Properties of Crystalline Copper Sulphate at Low Temperatures

THE principal magnetic susceptibilities of crystalline copper sulphate ($CuSO_4.5H_2O$) have been measured from room temperature down to about 90° K.[1]. From a detailed analysis of these magnetic data, Jordahl[2] finds that they can be explained quantitatively on the assumption that the crystalline electric field in the neighbourhood of the Cu^{++} ion in the crystal is predominantly cubic in symmetry, with a small tetragonal component superposed on it. The ground state of the Cu^{++} ion is ^2D, and the crystalline field postulated is such that under the influence of its cubic part the energy levels split up into two sets, the lower set having a two-fold *orbital* degeneracy, and the upper a three-fold one, the separation between the two sets being about 18,300 cm.$^{-1}$; the tetragonal part of the field separates the levels of either set by about 2,550 cm.$^{-1}$. Each of these separated levels will have a two-fold *spin* degeneracy, which, being of the Kramers type, will not be removed by the crystalline field.

The type of crystalline field postulated above for explaining the magnetic data appears, from the known structure of the crystal[3], to be plausible. Each copper atom in the crystal is surrounded by 6 oxygen atoms, 4 of which belong to 4 water molecules forming a square with the copper atom at the centre, and the other two belong respectively to two SO_4 groups, and are located centrally above and below the square. The copper-oxygen distance for the 4 water oxygens is about 2·0 A., and for the other two about 2·4 A.

The splitting of the ^{2}D levels of Cu^{++} that would occur in the above field cannot, however, be reconciled with two important observations made recently at the Mond Laboratory in Cambridge. Ashmead[4] has observed that the specific heat of $CuSO_4.5H_2O$ shows a maximum in the region of liquid helium temperatures, and Reekie[5] has found that the effective magnetic moment of Cu^{++}, deduced from susceptibility measurements on the powdered crystal, falls rapidly in the same temperature region. These observations indicate that there are two low-lying energy levels for the paramagnetic ion in the crystal, separated by a few cm.$^{-1}$, the lower of which is non-magnetic. The pattern of splitting of the ^{2}D levels contemplated above cannot be made to conform to these requirements.

A closer examination of the structure of the crystal, however, suggests a simple explanation. The distance between the copper atom and the 4 water oxygens, namely 2·0 A., is much smaller than would correspond to an ionic binding between Cu^{++} and these oxygens, and is just the distance that one should expect for a *covalent* type of binding between them. Such a planar quadri-covalent binding is indeed common in the cupric salts[6]. Such a binding, according to Pauling's theory of directed valence, will involve the orbitals dsp^2, and the odd electron in Cu^{++} displaced from the $3d$ orbital will now occupy the $4p$ orbital. The ground state of the $[Cu(H_2O)_4]^{++}$ complex will thus be a $^{2}\Pi$ state, and the magnetic properties of the complex will, therefore, be somewhat similar to those of the nitric oxide (NO) molecule, which have been investigated theoretically in detail by Van Vleck[7] and are well known. If the coupling between the spin moment and the component of the orbital moment conserved along the normal to the plane of the complex is very weak, and of the order of a few cm.$^{-1}$ (as against 121 cm.$^{-1}$ in NO), and the antiparallel coupling between them corresponds as usual to the smaller energy, then the results obtained by Reekie and Ashmead will follow naturally.

The experimental finding[1] that the *orbital* contribution to the magnetic moment of the $[Cu(H_2O)_4]^{++}$ complex is directed predominantly along the normal to the plane of the complex is significant.

K. S. KRISHNAN.

Indian Association for the
Cultivation of Science,
Calcutta.
Nov. 18.

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[1] Krishnan and Mookherji, *Phys. Rev.*, **54**, 841 (1938).

[2] Abstract published in *Phys. Rev.*, **57**, 349 (1940).

[3] Beevers and Lipson, *Proc. Roy. Soc.*, A, **146**, 570 (1934).

[4] NATURE, **143**, 853 (1939).

[5] *Proc. Roy. Soc.*, A, **173**, 367 (1939).

[6] See Pauling, "Nature of the Chemical Bond" (Cornell Univ. Press, 1939), p. 100.

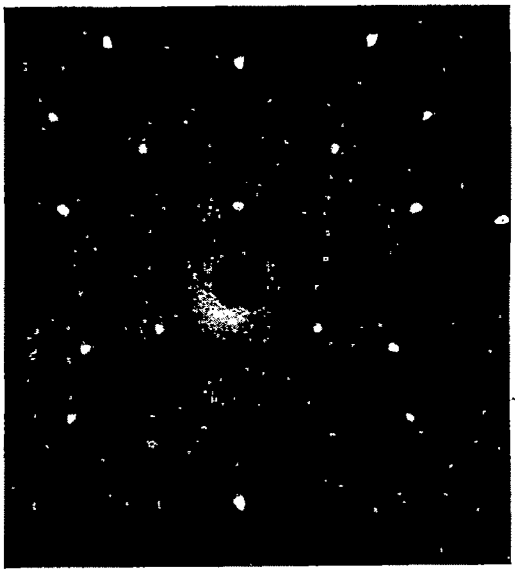
[7] See Van Vleck, "Theory of Electric and Magnetic Susceptibilities", (Oxford Univ. Press, 1932), p. 269.

Diffuse Reflections from Diamond

Sir C. V. Raman and P. Nilakantan have published Laue photographs of diamond[1] showing modified (111) reflections, consisting of an approximately circular diffuse spot, accompanied in certain positions by two diffuse streamers, near each Laue (111) reflection. These photographs were taken with the X-ray beam parallel, or nearly parallel, to a [111] axis, a [1$\bar{1}$0] axis being vertical.

We have investigated the changes in shape of these modified (111) reflections when the orientation of the diamond crystal is varied. Perhaps the most interesting form of the reflection is obtained when the crystal is rotated about the [1$\bar{1}$0] axis, so that reflection takes place from the *other side* of the vertical (111) plane. The angle of incidence θ is $-21{\cdot}9°$ (the Bragg angle for copper-$K\alpha$ radiation), when the two horizontal trigonal axes make angles of $-41{\cdot}4°$ and $+68{\cdot}1°$ respectively with the X-ray beam, and the modified copper-$K\alpha$ reflection then forms a diffuse background to the Laue (111) spot.

For values of θ less or greater than $-21{\cdot}9°$ the modified reflection is, as shown in the photograph, a triangle of three small spots surrounding a diffuse centre. For a range of values of θ from $-26{\cdot}8°$ to $-16{\cdot}5°$, the position of the *centre* of this triangle agrees with the simple Faxén formula $d_{111}\sin(\theta+\varphi)=\lambda\cos\varphi$, where λ is the wave-length, φ the angle of reflection. The radial apex of the triangle always points away from the Laue spot, and the triangle increases in size as θ departs from the Bragg angle, although the size of the three component spots does not appear to increase. The result of this is, of course, that the $K\beta$ triangle is larger or smaller than the $K\alpha$ triangle according as to whether it is farther from, or nearer to, the Laue position. Monochromatized photographs have proved that all three spots and the diffuse centre are due to characteristic radiation (as are the circular spot and streamers of the normal orientation); while low-temperature experiments show that the modified reflections, whether of these or of other shapes given in other crystal orientations, are only slightly reduced in intensity by a lowering of temperature of 200° A., a result to be expected since the characteristic temperature of diamond is very high.



Calculations are in progress using the formulæ developed by Waller in his dissertation[2]. Preliminary results fulfil the expectation that the Faxén-Waller theory in its complete form (that is, taking into account all the elastic constants of the crystal) is capable of giving detailed agreement with experiment. In the case of diamond a triangular intensity distribution has been calculated for the special crystal settings mentioned above, the triangular spot changing its orientation in the required manner when $\theta - \theta_{\text{Bragg}}$ changes sign, whereas a more nearly circular spot is calculated for the Râman setting.

These preliminary calculations indicate that the scattering phenomenon can be developed into a useful method of determining the elastic constants of crystals. Full details will be published later.

H. A. JAHN.
K. LONSDALE.

Davy Faraday Laboratory,
Royal Institution,
London, W.1.
Dec. 9.

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[1] *Proc. Ind. Acad. Sci.*, 11, 389 (1940).

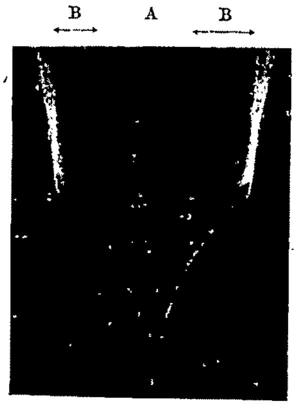
[2] Waller, I., "Theoretische Studien zur Interferenz- und Dispersionstheorie der Röntgenstrahlen". Uppsala Universitets Årsskrift, (1925).

Temperature and Latent Energy in Flame Gases

THE following facts relating to the travel of flame, initiated by an electric spark, through a homogeneous inflammable gaseous mixture have been established:

(1) Flame photographs show that the flame front during the early stages of travel is of low luminosity, but later it builds up a high luminosity indicating a high instantaneous pressure and temperature.

(2) Turbulent motion of the inflammable mixture before combustion has no influence upon the rate of travel of the flame front in the early stages, but has a marked influence upon this in the later stages[1].



It seems a fair inference that, in the early stages after ignition, flame is propagated as a result of the diffusion of activated particles from the flame front (that is, by chain mechanism), but that in the later stages it is propagated as a result of conduction and radiation of heat from the high temperature flame front into the adjacent unburnt gas—or perhaps it would be more correct to say that the propagation is thermally assisted in the later stages[2].

The condition of the flame gases left behind the flame front would appear to depend very largely upon the method by which the flame is propagated. That this is so may be seen very clearly from flame photographs in which the luminosity (afterglow) from the burnt gases is registered. The accompanying reproduction is from a photograph, taken on a moving film by Mr. S. G. Richardson, of the flame front and of the afterglow of the burnt gases resulting from the travel of flame through an over-rich carbon monoxide-oxygen mixture contained in a glass tube. It will be seen that the afterglow from the gases which are first burned (marked *A*) is considerable, but that from the gases burned later (marked *B*) is very feeble. The sudden change in the intensity of the afterglow is remarkable, but it may be correlated with a sudden change in the intensity of the luminosity of the flame front, which is much more clearly shown in series of instantaneous photographs of the flame front taken by Dr. O. C. de C. Ellis[3]. Other flame photographs[4] show that the intensity of the afterglow both in the *A* gases and in the *B* gases is governed by their temperature, but the intensity of the afterglow is not generally an indication of the flame gas temperature. Indeed, as preliminary measurements made by Dr. A. S. Leah by means of thin platinum-rhodium wires have shown, the temperature of the *B* gases is very considerably higher than that of the *A* gases.

Experiments with thin platinum-rhodium wires have been made in a very long (50 ft.) steel tube of 2 in. diameter, which was filled with a thoroughly mixed inflammable gaseous mixture and ignited by an electric spark placed at the centre of the tube[5]. The temperature attained by the platinum wires after the flame had passed over them approached the ideally calculated temperature for the gases when the wires were placed some distance away from the spark, but over the first 9 in. from the spark the wire temperatures measured were as shown below:

Distance from spark in inches	1½	8	9
Wire temperature, °C. ..	1570	1750	1810

It will be noticed that at 1½ in. away from the spark, at which point the flame gases probably resulted from a combustion propagated purely by chain reaction mechanism, the temperature of the wire was only 1,570° C., whereas at 9 in. away it was some 240° C. greater. Previous experiments reported[6] have led to the conclusion that the temperature of the flame gases resulting from the combustion of an inflammable gaseous mixture increases, and therefore the latent energy contained in them decreases, as the distance of flame travel from the igniting spark increases. The experiments now described give further support to this conclusion, and suggest that this is because in the early stages of combustion after spark ignition the mechanism of combustion differs from that in the later stages.

Bunsen burner flame gases result from combustion, the propagation of which is thermally assisted. Their temperature is therefore greater than that in flame gases resulting from combustion in the early stages after spark ignition.

W. T. DAVID.

Engineering Department,
University,
Leeds.
Dec. 12.

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[1] *The Engineer*, 733, Dec. 31, 1937.

[2] *The Engineer*, 509, June 7, 1940.

[3] See, for example, *Fuel*, 7, No. 11, 505, Plate XX, Figs. 1, 2, 3, and 4.

[4] See, for example, *Fuel*, 7, No. 9, 35, Fig. 1, Plate XV.

[5] David, Leah and Pugh, *Phil. Mag.* (in the Press).

[6] *Phil. Mag.*, 23, 345 (1937).

RESEARCH ITEMS

Origin of the Pentatonic Scale

THE late survival of a manner of life belonging to the Early Iron Age in the Hebrides has suggested to E. Cecil Curwen a study of the origin of and distribution of the pentatonic scale (*Antiquity*, December 1940) which occurs there in folk-song as, it was supposed, a unique instance in Europe. An examination of various collections of folk-songs showed that the scale of five notes occurred as a tradition strong in Scotland, fairly strong in Ireland, but weak in Wales and England. The scale of six notes (hexatonic), however, is almost as strong in England and Wales as in Scotland and Ireland. Western Europe (Brittany, France, Basque) is weak in pentatonic but still strongly hexatonic. In northern Europe there is a heavy concentration of pentatonics in the extreme north (Lapland), fringed by a moderately strong pentatonic tradition in Finland, the Faroes, and perhaps northern Russia. Farther south, pentatonics are weak, hexatonics numerous, except, possibly, in Germany. Fewer melodies have been acquired in southern Europe. Pentatonics seem to be confined to Greece and the Balkans, hexatonics here, too, being numerous, but weak elsewhere where the heptatonic scale prevails. Outside Europe the tradition is: Arab, highly developed heptatonic; India, heptatonic with an earlier pentatonic co-existing, and associated with a pre-Aryan population; Persia, resembling Hindu. This suggests a possible correlation between heptatonic scales and Indo-European languages. Elsewhere in Asia, pentatonic scales are common if not predominant—Mongolia, China, Japan, Siam, Annam, Java, also South Seas, New Guinea. In America and Africa, pentatonics are common or have been widely reported. This distribution suggests that the area covered by the Indo-European languages forms an island of heptatonics surrounded by an ocean of earlier pentatonics. The latter is vocal rather than instrumental, while the heptatonic is an instrumental scale and its distribution is a measure of the spread of harp, lyre or flute. These are considered to be of Asiatic origin, the harp appearing so early as the close of the fourth millennium B.C. (Jemdet Nasr). The heptatonic scale is therefore one of the arts of material civilization appearing with agriculture. In the process of diffusion from the East, it probably reached Great Britain in the Late Bronze Age with the Celtic intrusion, where it impinged upon a population descended from the neolithic megalith builders who had spread along the shores of the Atlantic and formed a pre-Celtic, prehexatonic population, possibly to be identified with the Picts.

Social Organization of the Haisla, British Columbia

THE Haisla, who occupy the upper reaches of the Douglas Channel, with Tsimshian, Kemano-Kitlope and Haihais as their nearest neighbours in the maze of channels east of Princess Royal Island, were visited in 1935 by an expedition under the auspices of the University of California with the assistance of the Social Research Council. Ronald L. Olson, in reporting on their social organization (*Univ. California Anthropol. Rec.*, 2, 5; 1940), appends notes dealing with the Kitlope (Kemano) tribe. The Haisla and Kitlope alone of the Kwakiutl-speaking tribes have a full-fledged maternal exogamic class organization. They say that the Haihais and Heiltsuk do not know how to marry, as they originate from a girl who "married" a dog. The Haisla have six clans, each named after an animal. Although the clans act as units in everyday matters, in most festivals (potlatches and feasts) they are (except for the Eagle) linked with one or more of the other clans. Clan affiliations and rank are of the utmost importance—even more important than the biological family. As the clan occupies one village only, village grouping is of no importance. There is no trace of a formal moiety organization, except for a curious institution among the boys. A line through the centre of the village divides the boys into two groups, regardless of clan. Anyone crossing the line alone is liable to attack. On occasion they line up for sham battles. This rivalry is encouraged by the elders. Each clan has a number of crests, as, for example, in the Eagle clan—eagle, sea otter, ermine, owl, shag, a creature like an eagle with down-turned beak, hawk, halibut. This clan is sometimes termed Owl. The titles of nobility or rank are as carefully guarded and kept as the crests. They are variable in number for each clan, some belonging to men, others to women. Some of the higher chiefs have one or more "seconds" or helpers whose title may be rendered as "speaker". Though commoners and never chiefs, they are highly respected. Only the highest chiefs may have speakers, and they must be of the same clan. The office is inherited in the same way as other titles through the sister's son.

Early Growth of the Human Skull

IT is a matter of common observation that at birth the human head is still in a plastic condition—certain races take advantage of this to produce deformities—and that until it becomes finally fixed in the adult condition it undergoes unequal growth in different dimensions. These changes have been fully studied by means of a series of measurements, and the results analysed statistically by C. B. Davenport (*Proc. Amer. Phil. Soc.*, **83**; 1940) on a full series of subjects. Apart from the detailed measurements which are given and illustrated by 170 growth-curves as examples, several general conclusions arrived at by the author are not without interest. First, due no doubt to the plasticity of the skull at birth, is the fact that environmental conditions play an important part in determining the final head shape. The changes in the proportions of the head are most marked in the first few weeks after birth due in part to the deformation caused by birth itself. Gravity has a flattening effect, which is noticeable as the child begins to sit up and to walk. Absolute cephalic measurements are less in the female than in the male in relation to her smaller size, and the mean cranial capacity is less in girls than in boys absolutely and in relation to stature and body modulus. The growth-curves of the heads of three pairs of monozygotic twins show that, while in each pair they may lie close together or sometimes apart, they run in parallel courses. In similar curves of dizygotic twins no such correspondence is exhibited. Negroes have the greatest head-length and head-girth, while Nordic children have the largest post-auricular head segment and the largest height/length ratio.

A Study of Bird Migration

Too often in discussing bird migration use is made of general and somewhat nebulous observations which do not provide ground for arriving at satisfactory conclusions. James Ritchie (*Proc. Roy. Soc. Edinburgh*, **40**; 1940) has furnished an example of the other method of approach by analysing, so far as possible, conditions associated with the appearance of an exceptionally large number of waxwings (*Bombycilla garrulus*) in Britain in November 1921 and checking this up with the corresponding records of the arrival of the same flights in Denmark. Accepting the not unreasonable assumption that the birds flew south at an average rate of twenty-five miles an hour and started in southern Scandinavia, as local records suggest, an explanation of their appearance in Britain can be given in terms of the direction and speed of the wind during the migration. This was generally one day later than the corresponding flights arrived in Denmark owing to the greater distance to be traversed. The author accepts the general proposition that the fundamental impulse to migration is associated with the reproductive cycle. He suggests that the birds tend to take off into the wind, so the direction of the wind may be a factor in determining the actual time of starting. In general, too, the migration took place in normal temperatures for the time of year following a sudden temporary drop and as a rule on cloudy or overcast days. It is suggested with regard to the latter conditions that they may enable the lung surface to keep moist without undue loss of the body water on a long-sustained flight.

Formation of Sand Cays

IN a paper on sand cays and their problems in the *Geographical Journal* of November, J. A. Steers traces the probable growth of these coral islets. The growth of the reef corals, the erosive action of waves in piling up blocks of coral rock, and the chance of seeds arriving and germinating are all familiar factors. He stresses, however, two other agencies in the growth of cays. Calcareous algæ, especially Halimeda, help in the formation of sand which adds compactness and solidity to the loose formation and so prepares the ground for wind-carried seeds of higher plants. This action is explained at greater length in a companion paper by V. J. Chapman. The second process in stabilizing the cay, and one that Mr. Steers regards as of great importance, is the formation of beach-rock. In tropical waters a great deal of calcium carbonate is precipitated on or just beneath the surface of beaches and has the effect of cementing the sand into hard surfaces like paving stones. These slabs dip with the inclination of the beach. Their formation is limited to a small vertical range which is governed by tidal range and wave action. In Jamaica the range is three feet; in Australia it is four feet. It is generally formed in patches and seldom encloses a cay. Its formation seems to depend on many factors, and possibly the presence of vegetation may be a factor. Once formed it protects the cay from wave action and encourages the growth of vegetation. But since it is rarely peripheral, wave action gets between and behind the slabs, and lines of beach rock may lie well away from the cays; some even lie at right angles to the shore of the cay.

Dipole Moments of Substituted Benzoic Acids

THE direction of the group moment associated with the carboxyl group has been considered by C. S. Brooks and M. E. Hobbs (*J. Amer. Chem. Soc.*, **62**, 2851; 1940) in connexion with measurements on benzoic acid and some *para-* and *meta-*substituted halogen benzoic acids. Since the acids are normally associated even in dilute solutions in benzene, dioxane was used as the solvent. The mean direction of the carboxyl group moment was calculated as 74° with respect to the C-C line. No conclusion could be reached as to free rotation, as the values are compatible either with free rotation or with an equimolecular mixture of molecules in which the carboxyl group is fixed in the plane of the ring with the O-H in *cis-* and *trans-*positions, respectively, with respect to the *meta-*substituent in the benzene ring. A small discrepancy between the expected and observed values of the moments of *p*-chlorobenzoic acid and *p*-bromobenzoic acid is attributed to a resonance effect between the halogen and carboxyl groups in the benzene ring.

Monochromatic X-Rays

THE production of X-rays is always highly inefficient, since the greater part of the electrical energy put in is lost as heat. Even so, the product is still chromatic. When monochromatic radiation is needed, the inefficiency is still greater. R. Q. Gregg and N. S. Gingrich have reported (*Rev. Sci. Instruments*, October 1940) an interesting experimental comparison of the use of crystal-reflection and of filtration to get a monochromatic beam of molybdenum $K\alpha$ radiation ($\lambda = 0{\cdot}708$ and $0{\cdot}712$ A.). Although their special interest was in the X-ray diffraction patterns of liquids, the results are applicable to all work for which monochromatic X-rays are essential or desirable. In one set of experiments, using a General Electric Co. Mo-Target tube with an applied peak voltage of 37·0 kv., the diffraction patterns of liquid sodium were got after the original radiation had been reflected from calcite or from rock salt crystals, or after it had been filtered through various thicknesses of zirconium oxide with or without the addition of aluminium foil. The actual times of exposure used to blacken photographic film varied from 11 hours, when the direct beam from the X-ray tube was used, to 162 hours, when calcite reflection was used. When the times of exposure were reduced to times needed to produce an image density of 1, the differences were strikingly illustrated. Thus, the times were, for no filter, 8 hours; with rock salt reflection, 58 hours, and with calcite reflection, 356 hours. The general conclusions are that under these conditions calcite reflection is impracticable, that short exposure times can be obtained by using impure radiation, but that none of the reasonably satisfactory degrees of filtration is any more expedient than the use of rock salt reflection. The dangers of using partially filtered X-rays where a monochromatic beam is needed are well illustrated in graphs showing how an entirely spurious peak may appear on the intensity curve of the diffraction pattern.

RAILWAY RATIONALIZATION

ALTHOUGH railway speeds in Great Britain are generally good, the average speed at which a traveller could accomplish a series of random journeys by rail is likely to prove very disappointing. No doubt, many passengers ask themselves if something better were not possible, but seeing no solution to the problem, accept the position as inevitable. That it is a state of affairs which can be improved by a rational system of reorganization, leading possibly to the doubling of the average speed, is the contention put forward by Mr. J. F. Pownall in a booklet entitled "New Railway Network Principles" (Birmingham: Cotterell and Co. 2*s*.). This contains the gist of the chapters of a book dealing with one of two projects relating to waterways and railways in Great Britain which have had to be set aside to await the advent of better days.

Now, however, is the time for such ideas to be broadcast so that when these better days come we may be prepared to make such changes in our present system as will restore the railways to the position they once held in the estimation of the public. The author has taken a journey of 2,342 miles, from one town to another and then to a third and so on, and finds from "Bradshaw" that the average speed works out at 16½ miles an hour. His method of improving this is based on an ideal network of equilateral triangles of 50 miles side, and along the sides of these triangles fast trains would start precisely at each hour and arrive 52 minutes later. This gives 8 minutes at each junction for changing if necessary. Slow, stopping trains would also run, taking about two hours for the same journey, and by their means a traveller starting from an intermediate station travels at about 25 miles per hour to the first junction, then on by fast trains at 50 miles an hour, and lastly to an intermediate destination by a slow train at 25 miles per hour.

Turning then to the practical application of this ideal system, the author shows that by certain modifications of the present lines a workable system of railway operation can be developed so that the original series of journeys could be accomplished at 31½ miles an hour, or in a total time of 74 hours instead of 142 hours as planned from "Bradshaw". This remarkable saving of time is but one—the principal one—of many advantages of the system. Another is the simplicity of time-tables, since trains would always start from the junction stations precisely at the hour and from intermediate stations always at a fixed number of minutes after the hour.

The fast and slow trains referred to are in addition to the main line expresses, and thus, if any substantial part of a journey such as that described followed these main lines, a further saving of time is probable. A similar scheme is put forward for the improvement of goods traffic on the railways, but when the author suggests that the loading gauge should be made considerably larger than at present, he enters upon a phase the cost of which would almost certainly heavily outweigh the advantages it would confer. Many of his proposals are, however, quite feasible and only need a change of outlook from our present markedly conservative one. The new type of junction station, the standardization of trains, the co-ordination of rail and road services, and many other details deserve—nay, rather demand—from us all very careful consideration and thought, for, when all is said, the scheme involves a revolutionary change of mind as to the place of railways in our mode of life.

A.R.P. COMMUNICATION

W. P. WILSON describes in the Engineering Supplement to the *Siemens' Magazine* of November the A.R.P. telephone and signalling system, A.R.P. (No. 186) devised by Messrs. Siemens. One of the essentials of any system is the provision of a trustworthy method of giving the various signals required, and maintaining rapid communication between the personnel concerned. For obvious reasons it is not desirable for private A.R.P. organizations to use sound signals; it is usual, therefore, to employ bells or buzzers and visual lamp signals of various types, communication being maintained by a suitable telephone system.

In some cases existing private telephone systems can be used or adapted to meet the conditions, but it is generally found that a separate system designed to meet the special conditions is the most desirable. This is particularly the case where large schemes are concerned. In such instances it is usually advisable to supplement any existing telephone system by an entirely separate emergency scheme in order to safeguard against the failure or destruction of the regular telephone system.

The mere knowledge of the existence of a reliable communication system greatly assists in dispelling feelings of isolation or panic on the part of the staff of the organization concerned. One of the essential things to consider in connexion with a communication system is the probable short time available for taking action after the receipt of a warning. This is particularly the case under the recent arrangements of the 'spotter' system. Communications include both telephone and signal systems, the former to provide complete control of the A.R.P. personnel, and the latter to indicate clearly to the whole staff the action to be taken.

The telephone system, which should be planned to meet individual requirements, should be easy to operate and also to repair. For most cases a simple system of magneto telephones is believed to be the best. Magneto telephones are self-contained units, each has its own ringing apparatus and its own battery for supplying the speaking current, thus eliminating the risk of breakdown due to the failure of a central battery. Further, two or more magneto telephones can be connected together at the control board, and they can then ring each other direct without the assistance of an operator. If the control board is put out of action the line wires can be quickly connected so that the telephones continue in service by means of code rings. This is not feasible with central battery sets.

The telephones recommended are equipped with powerful magneto-generators and high-resistance bells, enabling a number to be bridged across one pair of wires if desired. They are fitted with 'neophone' hand-microtelephones to improve speech transmission. Portable telephones are provided for by 'looping in' one pair of wires at each point and fixing a 2-pin weatherproof socket. A lamp calling-system in addition to the bell can be fitted when the telephone is to be used in a very noisy position.

A.R.P. signals can be either visual or audible or a combination of both. The signal system usually consists of a starting switch which puts into action loud-ringing bells, hooters, etc., where large staffs are to be controlled, and buzzers or single lamps for offices and small staffs.

AN EXPERIMENT IN BIOLOGICAL CONTROL

THE control of injurious forms of insect life by the application of biological methods has, in a number of instances, proved remarkably successful. Other methods of control in such cases had been of little avail or were impracticable. Success achieved by the utilization of the natural enemies of injurious insects has usually proved to be relatively inexpensive and of a more or less permanent character. As a rule the most favourable conditions are those afforded by tropical or subtropical islands where the dissemination of the beneficial introduced insects meets with few handicaps or barriers. Recently an experiment in the biological control of coconut pests in Seychelles has been recounted (*Bull. Entomol. Res.*, **31**; 1940).

The author of the paper in question, Mr. D. Vesey-Fitzgerald, mentions that the affected crop is of special importance, since its product, copra, is the main export of Seychelles. The pests concerned are scale insects (*Coccidæ*), and of these, four species were specially injurious. It is noteworthy that the species in question, namely, *Ischnaspis longirostris*, *Pinnaspis buxi*, *Chrysomphalus ficus* and *Eucalymnatus tessellatus*, are unknown as major pests of coconut in other countries, while the brown scales, that are usual pests of this crop, are not found in Seychelles. Other Coccidæ were also found to be infesting coconut in this area, while a large variety of different species were noted as attacking the general vegetation.

This fauna needed investigation, as it concerned the main problem, and as a result it became evident that general rather than specialized enemies of Coccidæ required searching for. Species that would, in fact, attack all the different scale insects without special preference were obviously needed, since the elimination of a particular kind might result in an increase of some other species. The life-history and special requirements of each of the four species, already named, are described and their incidence on the coconut is discussed.

In order to combat these Coccidæ, four species of Coccinellid beetles were introduced from East Africa. The species were *Chiloconus distigma*, *C. wahlbergi*, *Exochomus ventralis* and *E. flavipes*. Since the journey from Mombasa to Seychelles takes only three days by steamer, these predators could be landed there within a week of leaving the centres where they were bred in East Africa.

The breeding technique and the establishment of each of these species is dealt with. Records covering three years are given in order to show the effects of the introduced predators on the population of scale insects. The figure quoted shows that the introduced enemies are reducing the scale insects below the density at which they cause economic loss. Also it seems that the reduction of one species of pest has not been followed by a correlated increase of another species.

ELECTRICITY IN AGRICULTURE

REFERENCE has already been made in NATURE (Jan. 11, p. 62) to the report on the utilization of electricity in agriculture and horticulture prepared by C. A. Cameron Brown and issued by the Electrical Research Association. The Instit [illegible] Engineers is now publishing wri [illegible] to the discussion of this report. Th [illegible] appears in the Institution's *Journ* [illegible]

Mr. H. W. Grimmitt, of the st [illegible] drive, and there is evidence of enthusiastic co-operation from the agricultural research institutions and also from the Ministry of Agriculture and the Agricultural Research Council. As a preliminary to [illegible] E.R.A. has had prepared a com- [illegible] whole field of research on the [illegible] nation on past work [illegible] for future work. [illegible] investigate by wages, etc., have, as in many other branches of farming, lent greater weight to any considerations of labour saving or the obtaining of first-class results with comparatively unskilled or newly trained labour. The mechanical milking machine is an outstanding example of such a case. Americans are definitely in favour of milking machines, largely because of the labour-saving aspect. Official figures show an average increase of 112·7 per cent in the output of milk per hour of labour and, in all, a labour-saving of 52·1 per cent.

Cooling the milk after milking is another vital step in the process which does not always receive the attention it deserves. Here again, electricity is the best source of power, with attractive characteristics to the supply authority, the connected load being from ½ to 1 horse-power, and the return some 500 to 1,000 kwh per consumer per annum for a 30-cow herd.

Water supply is second only to field work in essential importance on the farm ; on the dairy and stock farm it might almost be awarded the premier place. The tendency is still to make a simple substitution of an electric motor for the previous source of power, in ignorance of the increased opportunity afforded by electrical operation and of the great advances made in recent years. The most notable has been the perfecting of the small automatic air-pressure controlled set ; the full utilization of this method of water supply gives all the advantages of main water supply but at a substantially reduced cost.

A vital requirement on a dairy farm is the provision of hot water and steam for the essential washing and sterilizing of dairy appliances and utensils. There is no technical difficulty in doing this electrically, and to the electrical industry it is a very attractive load. On an average farm the washing and sterilizing requirements alone could account for a consumption of 500–1,000 electric units a year.

On the poultry farm, too, electricity can play a substantial part.

For several purposes, the use of power for grinding mills and general farm-yard loads is used extravagantly on many farms at present. For example, a grinding mill taking anything from 5 h.p. to 15 h.p. may be used for only a few hours weekly. By suitably using a much smaller mill of a simpler and more foolproof type and leaving it to run all day and all night if required, the power requirements may be reduced to about one fifth of what they were before for the same amount of total work. In threshing, the traditional method of using a large thresher requiring about 15 h.p. could be modified to enable correspond-ing work to be done over a long [illegible] reduction of about 50 per cent i [illegible] To the farmer the at [illegible] bugbear of pro [illegible] removed as h [illegible]

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, January 20

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir David Chadwick : "Some Problems of World Economic Development" (Cantor Lectures, 1).

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Commandant J. Hackin : "Routes anciennes en Afghanistan".

Tuesday, January 21

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Dr. Gilbert Murray : "Hellenism".*

WARBURG INSTITUTE (at the Imperial Institute Buildings, London, S.W.7), at 2.30 p.m.—Dr. O. Kurz : "Stellar Divinities in the East and the West".

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, London, S.W.1), at 1.30 p.m.—Mr. Herbert Cecil Whitehead : "The Design of Sewage-Purification Works".

Wednesday, January 22

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir Alan Cobham : "Flight Refuelling".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Mr. Frederick Chapman : "On the Sequence and Age of the Rocks in Borings in the Atoll of Funafuti". Dr. A. G. Jhingran : "The Cheviot Granite".

Saturday, January 25

INSTITUTE OF PHYSICS (London and Home Counties' Branch) (at the Research Laboratories of the General Electric Co. Ltd., Wembley), at 2 p.m.—Conference on Industrial Radiography (Chairman : Dr. V. E. Pullin). Mr. H. P. Rooksby and Miss K. L. Jackman : "Applications of Radiography to the Electrical Industry" ; Mr. W. L. Harper : "X-ray Examination of Light Alloy Castings" ; Dr. L. Mullins : "Recent Developments in the Photographic Aspects of Radiography".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned :

LECTURER IN COOKERY AND DIETETICS to the Liverpool Education Committee—The Director of Education, 14 Sir Thomas Street, Liverpool 1 (January 22).

TEACHER OF SPEECH TRAINING in the Aberdeen Education Committee's Schools—The Director of Education, Education Offices, Municipal Buildings, Castle Street, Aberdeen (January 25).

[illegible] in the Leicester Education Committee's Schools [illegible]cation, Education Department, Newarke Street, [illegible]

[illegible]EACHERS to the Bradford Education Committee [illegible]cation, Town Hall, Bradford (January 25).

[illegible]MATICS at the North Staffordshire Technical [illegible] Governors, Town Hall, Hanley, Stoke-on-

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LEADERSHIP IN CIVIL DEFENCE

IN the searching ordeals of bomb and fire through which one after another of our great cities have passed, the fortitude and courage of their citizens has time and again overshadowed material destruction. Few can pass along those stricken streets without being inspired by the capacity of men and women to rise above discomfort, sorrow and heavy loss, or without viewing in the splendour of the human spirit revealed alike in the work of civil defence, or of caring for the homeless and suffering, an earnest of our powers to build better when the opportunity comes. The unconquerable spirit revealed in the address of the City Architect of Coventry before the Royal Society of Arts early in December attests that the opportunities are already realized, and that out of the present evil, as from a forest fire, may come greater riches and beauty.

The patient heroism and stedfast service which so many citizens have displayed in these days of trial should not lead us to imagine that all is well, even in the human element. The reports of the Horder Committee show how much still remains to be done for the safeguarding of health in public shelters, and in the repair of ravages in the welfare services. Education itself is a victim of air warfare which even yet has shown no sign of approaching convalescence. The extension of the principle of compulsory fire watching is itself a reminder of a field in which there has been the gravest dereliction of duty both by corporations and by individuals.

The response to Mr. Herbert Morrison's appeal for the immediate formation of fire-bomb fighting parties in business and residential districts shows that the ordinary citizen is now fully alive to this particular danger and is eager to play his part. It may be true that in Great Britain we must have experience before we do our best. Even the stern teaching of the school of fire precautions in London was ignored by many until the lesson was learned in their own hard school. That the lesson has been well learnt has since been shown by recent experience in Cardiff, Bristol and elsewhere.

In spite of this national failing, it is not with the individual citizen that the chief weakness or danger lies, whether in this matter of fire-fighting or other questions. That lies rather in the failure of the Government to use to the full the wide powers with which it has been entrusted, and in the absence of real leadership which has characterized both Government policy and local authorities in various fields. Few as may be those who seek to evade their responsibilities and duties, unless the Government is prepared to deal with the offenders in such matters as fire-fighting, the training of labour, the evasion of rationing, neglect of cultivation, to indicate only a few widely differing fields, the defection of the few may involve the whole community in severe suffering and hardship.

If, therefore, the amended Fire Watchers Order is to prove adequate, there must be no failure to enforce it by stern penalties where necessary. Weakness at this point may invalidate the efforts of the many and defeat the purpose of the whole organization for dealing promptly and efficiently with the menace. It is always at its weakest link that the chain is tested. Evidence that the Government was determined to act vigorously in this matter where required and prepared to institute the necessary inspectorate to collect any evidence of neglect would have a moral effect reaching far beyond the field of fire-fighting.

No less important, however, is the question of leadership or direction. Unless that is wise and effective, the fullest use cannot be made of the zeal and courage and heroism of the individual, either as the private citizen or as a member of the civil defence services. There is lamentable evidence that damage has been done which could have been prevented because fires were not tackled rightly at the start, and because no one in the area had been made responsible for judging what kind of a fire it was, its peculiar dangers, and for seeing that the proper number of machines was there. In fire-fighting no less than in other warfare, there must be efficient command.

It is no fault of the Auxiliary Fire Service that its firemen are not strategists and that its own officers lack the experience of the long-trained fire expert. Something must be done to supply the necessary direction to this valuable and immensely willing force. Adoption by all cities and towns of the London practice, according to which all fires in a defined area are watched over by a senior officer in control of fire, has much to commend it. This officer patrols round them, directing operations, giving advice, and is expert enough to know what assistance may be needed. If junior officers accompanied him, this strategist might even run a school for strategy.

A major purpose of the Fire Watchers Order is to increase the efficiency of the fire services, setting them free to concentrate their energies, by the systematic prevention of unnecessary fires. It should be a first duty of the new fire prevention executive to increase that efficiency from the other side by strengthening command and strategy. Nor is it only in the field of strategy that command needs strengthening. The neglect of the firemen on duty has been a most lamentable feature of more than one of our great cities in their recent ordeals. Admirable arrangements for caring for the homeless by the provision of accommodation and meals have existed side by side with a scandalous neglect to provide rest or food for the men continuously engaged for long hours in bringing the fires under control.

There is, indeed, unmistakable evidence that some fire organizations and the authorities controlling them have yet to learn what is really implied by Napoleon's dictum that an army marches on its stomach. Neglect of the physical welfare of the auxiliary firemen may be as detrimental to the efficiency of the fire-fighting services as the absence of strategy, and is an equally damning indictment of the command. What is more, it is deeply resented by the many citizens to whom it has been obvious in recent weeks, and who to their honour have sought by private generosity to repair official neglect.

These are among some of the matters to which Mr. W. S. Morrison and Sir John Greenly may rightly be expected to give their attention when they have selected the personnel of the new fire prevention executive, if there is not in the meantime a speedy improvement in the situation. Important as they may be, they are, however, only mentioned here as illustrations of the damage which defective command or inefficient administration may do to the national effort. Administrators who are unequal to their task must be removed from office as ruthlessly and unhesitatingly as generals or admirals or air-marshals whose powers have been overtaxed by command.

It will be well, therefore, if deficiencies in direction, and command which have been revealed in our civil defence services by recent events stimulate further attention to this vital matter of leadership. The consequences which can flow from defective leadership, whether through lack of vision or organizing capacity, or administrative inefficiency, are too far-reaching to be disregarded. They may equally impede the smooth supply of munitions for the forces, raw materials for our factories or provisions for the civil population, impair the efficiency of a civil defence body such as the Auxiliary Fire Service, or deal fatal blows at the morale of the nation, upon which the sustenance of our war effort finally depends.

There is urgent need for searching scrutiny from above of almost every side of civil administration and leadership. Some, indeed, have already received attention from the Select Committee on National Expenditure, and the wide range of the admirable reports which that Committee has already issued suggests that such a further survey of civil administration and command might well come within its orbit. It may at least be hoped that the Government will speedily implement such an inquiry, whether through the Select Committee or some and other preferred means, and take the immediate and appropriate action on its findings. Only so can we ensure that parochialism, departmentalism and administrative incapacity no longer offer the barrier to our national effort which they have long offered in local government and to the development of regionalism, and which, if unchecked, they will assuredly offer to post-War reconstruction.

STATE PLANNING OF RESEARCH

The Contempt of Freedom:
the Russian Experiment and After. By M. Polanyi. Pp. ix+116. (London: Watts and Co., Ltd., 1940.) 5*s*. net.

IMPATIENCE at the delay in attaining the higher level of human welfare which science has made possible has led to a movement for the organization of research under State control and its more direct application to industrial and economic ends. Prof. Polanyi subjects this movement to a profound and penetrating criticism. He concludes that it would tend to lead to the loss of freedom of thought and freedom of expression of views contrary to authority and shows that this is, indeed, what happened in the U.S.S.R. with the vertical organization of research to State ends and under State control. The results of State planning of research are as disappointing as the results of the economic and social planning which he also discusses.

This book contains a message and a warning for scientific workers enamoured of planning. The first objective of planning should be the maintenance of freedom of thought and expression where it still exists, and its return where it has been lost. This freedom is absolutely essential for original research. It is also the first essential for human progress. People in authority, even in democratic countries, may resent the exercise of this freedom by those under them. It can easily be lost unless it is continually defended and fought for. We are not so many generations removed from the time when expression of views different from those held by the Church or the State was followed by persecution and even death. In most of Europe to-day the torch of liberty has been extinguished. Truth is being forcibly suppressed, and public opinion moulded for State purposes by open and hidden forms of propaganda, which prevail because those who know the truth are rendered dumb.

Even in democratic countries, there is a danger of the voice of reason being drowned in the flow of political propaganda, and the organization of science by the State may deprive scientific men of the full liberty of expression and freedom to criticize the policy of those in authority. The only authority scientific workers acknowledge is the truth. In these dark days through which civilization is passing, probably the most valuable service which men of science can give to humanity is the defence of freedom, described by Milton as "the liberty to know, to utter, to argue freely according to conscience which is above all liberties".

PHOTOSYNTHESIS BY PLANTS AND BY CHEMISTS

Photosynthesis
By Prof. E. C. C. Baly. Pp. vii+248. (London: Methuen and Co., Ltd., 1940.) 15*s*. net.

TWENTY years ago Prof. Baly first became interested in the debate whether formaldehyde could be photosynthesized artificially in a solution of carbon dioxide. Since then he has been continuously engaged in restating, retesting and reconsidering the problem. Now, in his retirement, he fights his battles over again within the covers of this book, recording successes which advance far beyond the first objective. Not only has formaldehyde been produced, but also glucose; a starch; the bases imidazole, pyridine and piperidine; coniine and two other alkaloids; α-amino-acids, including histidine; and a protein the molecular weight of which is given as 221·4. Very few of these substances have ever been photosynthesized in any laboratory other than that of Prof. Baly.

The path leading to these results has not been facile; on the contrary, the conditions of success have often proved stringent, and apparent successes, even though not illusory, have not always proved to be quite what they at first appeared. As an example the synthesis of mixed carbohydrates with the assistance of nickel carbonate may be mentioned. An independent attempt at repetition failed completely, to the emphatically expressed surprise of the author, who had believed the results to be reproducible and their confirmation a simple matter. It proved in the upshot to be far from such, and neither Prof. Baly nor anyone else has yet succeeded in repeating the results originally obtained in 1928. The margin between success and failure is believed to have been the chance use of a glass of abnormally low solubility which it has not been possible to get again.

With so much hanging upon so slender a thread, it would obviously be an impertinence for one who has not engaged in the actual experiments to comment on their technique and value. It is enough to record that, with the closure of the approach through nickel carbonate, recourse was had to the oxide, either suspended as a powder or supported on a kieselguhr base. The addition of thorium oxide in the ratio 1 ThO_2 to 24 NiO led to what Prof. Baly entitles "The Final Achievement". "When kieselguhr, which is completely coated with a tri-molecular layer of these oxides, is irradiated in presence of water, saturated with carbon dioxide, by daylight or the light of a tungsten filament lamp, there is photosynthesized a carbohydrate." This carbohydrate is not, however, a common one. After hydrolysis with sulphurous acid—but not before—it gave a Molisch reaction, and it passed slowly at room temperature and rapidly at 60° C. into a starch. The identification of the starch was carried out by hydrolysis with taka-diastase and boiling with Fehling's. This might be thought a little clumsy, since taka-diastase is not specific to starch nor Fehling's to glucose, or even to sugars. The only reference made to an iodine-blue test (a somewhat obscure one on p. 200) considers its negative result not surprising.

Prof. Baly is greatly impressed by the similarity between his nickel-catalysed photosynthesis and the natural chlorophyll-catalysed process in plants. Nickel oxide has a higher oxidation form in nickel sesquioxide, just as chlorophyll A has chlorophyll B. Both are green. Photosynthesis *in vitro* (1928 results) and *in vivo* both have a temperature optimum at about 30° C. and, by a fortunate selection of the physiological data, their Q_{10}'s have been made to appear the same. Both processes show a falling yield per unit quantity of light with rising light intensity; and the author believes that both may give rise to a starch without the free formation of any simpler substance. He is able to conclude "There is little doubt, therefore, that the mechanism of photosynthesis is the same in each."

The weight attached to the argument by analogy can only be described as crushing. Since nickel oxide requires thorium oxide to develop its activity, it is assumed that chlorophyll must need a similar inactive substance. The author is aware that some plants possess traces of boron in their leaves and will not grow normally in its complete absence. On this evidence he is prepared to believe "This function" of boron "would undoubtedly appear to be identical with that of thorium oxide in the case of nickel oxide."

On such analogies the author proposes a theory of natural photosynthesis which is in some respects remarkably explicit. It may be summarized by the equations:

(1) $C_{55}H_{72}O_5N_4\ MgCO_2H_2O + h\nu_1 = C_{55}H_{70}O_6N_4\ MgH_2O.CHOH$,

where $\nu_1 = 7{\cdot}1799 \times 10^{14}$;

(2) $C_{55}H_{70}O_6N_4\ MgH_2O.CHOH + h\nu_2 = C_{55}H_{70}O_6N_4\ MgH_2O + CHOH$,

where $\nu_2 = 4{\cdot}1615 \times 10^{14}$ and CHOH is activated formaldehyde;

(3) $C_{55}H_{70}O_6N_4\ MgH_2O + C_{40}H_{56} = C_{55}H_{72}O_5N_4Mg + C_{40}H_{56}O_2$;

and a fourth unformulated process in which xanthophyll is reduced back to carotin with liberation of free oxygen.

Referring to this mechanism, the author makes two statements: ". . . the mechanism of photosynthesis has been found . . ." (p. 210) and "No experimental proof of this mechanism of photosynthesis in the living plant can be adduced . . ." (p. 182). To any plant physiologist it must bristle with improbabilities. It is possible here to mention only a few at random. The transition from chlorophyll A to B is not a simple act of oxidation, and the location of the additional oxygen atom, now known to be in an aldehyde group, makes the process difficult to imagine. The necessity for light of two different wave-lengths rests upon very slender evidence; nor is any attempt made by the author to substantiate his assertion that the small leak of unwanted wave-lengths is sufficient to produce the photosynthesis observed in "monochromatic" lights. By the author's own computation a two-quantum process would require quite incredible energy efficiencies: observation uncertainly suggests a minimum requirement of 4 quanta. Although reduction of chlorophyll B hydrate by carotin is regarded as "the only possible mechanism of the third reaction of the photosynthetic cycle", there is as yet no evidence at all that the yellow pigments take any part in the process. The kinetic equations developed from the above are said to give a quantitative explanation of the relation between rate and controlling factors, including temperature, although the thermal reaction leading to the evolution of oxygen is not formulated. The meaning attached to "rate of photosynthesis" is not defined; but in the experiments of Warburg and Emerson which are used as tests, the rate measured was that of oxygen output.

After a careful reading, one may perhaps be forgiven for suggesting that this book could have been greatly improved by a more thorough elimination of inconsistencies and loose analogies, and by a deeper consideration of modern photosynthetic studies. W. O. JAMES.

THE CONTROL OF DISEASE

Man, Microbe and Malady
By Dr. John Drew. (Pelican Books.) Pp. 218. (Harmondsworth and New York: Penguin Books (Allen Lane), Ltd., 1940.) 6*d*. net.

The Conquest of Bacteria
from 606 to 693. By Dr. F. Sherwood Taylor. Pp. 144. (London: Martin Secker and Warburg, Ltd., 1940.) 6*s*. net.

(1) MR. H. G. WELLS remarked a little while ago that the only books worth buying to-day are the sixpenny editions. This tongue-in-cheek statement may have achieved little except a salutary effect upon Mr. Wells's publishers, but there can be no doubt that the cheapness and the increasing range of titles offered as 'paper-backs' is not only extending the numbers of the reading public but is also contributing very greatly to a more rapid dissemination of original thought and research among lay readers. In no case is the latter measure more desirable or necessary than in the field of science. This is significantly so in those practical and social implications which cannot fail to add to the more vigorous pursuit of health. For this reason Dr. Drew's book must be rated of the first importance. Its price does not run parallel with paucity of material nor with lack of care in presenting it. While it has been written primarily for the general reader, "Man, Microbe and Malady" would not make unprofitable reading for medical students or general practitioners.

A suitable introduction to enable the non-biologist to grasp the real nature of bacteria is followed by an account of their methods of infection and transmission, together with descriptions of the protective mechanisms, both natural and acquired, of the human body against bacterial attack. Some of the more common bacterial diseases are described in a further section, succeeded by chapters on the part played by insect and animal vectors in spreading disease. A concluding chapter on bacterial warfare minimizes the possibilities of its adoption to-day, while in an epilogue the author wisely addresses himself to those individuals who might develop phobias about certain diseases after reading a book of this nature.

The book would be valuable if only as a means of enlightening the general public as to the perniciousness of many patent medicines, and the imaginary complaints which they are designed to remedy such as night-starvation. Drew does not flinch from exposing the multifarious concoctions that are advertised so skilfully and spuriously as the infallible elixirs of life.

One section on diseases of the genital system is refreshingly frank and outspoken. In view of Mr. Malcolm MacDonald's recent utterance in the House of Commons that there are indications of increases in the number of new infections in all parts of the country, this is particularly opportune. Because of their extreme national importance, one or two of the statements need careful scrutiny. The author's dogmatic remark that 10 per cent of the population of Great Britain are syphilitic is open to question; the widest possible estimate would not place this figure above 4 per cent, while it is probably much lower. One shares all the author's commendable anxiety to convince British citizens of the terrible consequences of untreated venereal infections; but one cannot believe that more will be achieved by exaggerating the true position.

One point that may cause unnecessary alarm and misgiving to some of his readers lies in the author's ambiguous statements about the hereditary nature of syphilis. The direct reference to hereditary syphilis is unfortunate, especially as great care is taken later to describe its sometimes *congenital* origin. The bald remark that the taint of syphilis can be passed on to the third, and possibly even the fourth generation, might have been qualified by a paragraph on the methods of transmission in these cases and by a reminder that they occur with extremely low frequency.

The author's attitude towards prostitution, if acted upon, might be one of the most effective methods in checking the spread of the venereal diseases. In order to safeguard the general health of the nation he suggests that "we should take the common-sense view of prostitution" and then implies that we should establish brothels in Great Britain. The moral sanction invoked would be vigorously contested by our religious leaders, while Drew's citation of France as a country where the "logical attitude towards immorality" has been found satisfactory in controlling these diseases would need greater support from official figures than has hitherto been available.

A very small point: the present shortage of onions should do much to assuage the author's feelings about the allergic relationship between these greatly sought after comestibles and pregnancy.

(2) The use of drugs as therapeutic agents has been investigated for many years; but, apart from quinine, it seems only a short while since really fruitful results have been obtained. Ehrlich's discovery of salvarsan—so skilfully portrayed

in the film called "The Magic Bullet" which is now being shown in the provinces of Great Britain—together with the elaboration of Bayer 205 (against sleepy sickness) and emetine (against amœbic dysentery) were followed by the production of the remarkable drug prontosil, by Gerard Domagk and his co-workers at Elberfeld in 1932–35.

Since that time intensive research into the sulphanilamide compounds has culminated in the discovery of M. and B. 693 (which is as far as this book goes), a drug which is of tremendous significance in the treatment of certain streptococcal infections and which has already saved thousands of lives.

These outstanding advances in chemotherapy are the theme of this well-written book. It has been prepared for the layman; but, since it is the first to deal with these important matters in present-day medicine, it should secure many readers from the medical fraternity. For the latter, particularly, the book would have been even more valuable if Dr. Taylor had quoted statistics indicating the number of relapses after M. and B. 693 treatment for gonorrhœa. Conflicting reports tend to suggest that these relapses occur more often than was realized when this treatment was originally introduced.

T. H. HAWKINS.

A QUESTION OF TASTE IN PHYSICS

The Special Theory of Relativity
By Prof. Herbert Dingle. (Methuen's Monographs on Physical Subjects.) Pp. vii+94. (London: Methuen and Co., Ltd., 1940.) 3*s*. 6*d*. net.

THE scope of this book is indicated by the fact that it is based on lectures to honours physics students, and the treatment by the fact that it follows the lines of Prof. Dingle's recent contributions in NATURE. The interest provoked by the latter may justify the length of the present notice.

Dingle states the principle of relativity as, "There is no meaning in absolute motion". It might have been better to start with the more positive assertion that, when we speak of a velocity, we mean the relative velocity of two particles, and that the theory of relativity is concerned with the composition of such relative velocities. For Dingle seems to imply that his principle involves at the outset an advance on the ideas of classical mechanics. But that this is not necessarily so is shown by the fact that, if we let "c" tend to infinity in the formulæ of special relativity, we recover those of classical mechanics; this mathematical operation would not re-introduce "absolute motion" into a theory which attaches no meaning to it.

The same sort of *a posteriori* examination shows that the formulation of special relativity is essentially bound up with the introduction of this finite constant "c". This is in every development sooner or later identified with the velocity of light. In one like Dingle's based on "relations first discovered in the world of experience" we expect, therefore, to find that observational results on the propagation of light form the real starting-point. This expectation is in fact fulfilled in his book, but, instead of immediately making what has come to be the traditional use of the results, he first introduces a postulate about length, and later reverts to the traditional method to derive the Lorentz transformation (though remarking that it could have been derived from results already stated). Moreover, his derivation is defective, since it applies only to events on a light-track (equation 19).

Thus the author's procedure seems rather to obscure than to clarify this crucial part of the subject. The difficulties are traceable to two reasons: his desire to treat the measurement of length as more rudimentary than that of time, and his desire to avoid the introduction of more than one observer (both of which he has expounded in his articles in NATURE). There is no fundamental objection to the principles underlying these desires. However, it seems to the reviewer that Dingle does not rigorously follow out their implications, but, in some respects, pays mere lip-service to them while implicitly drawing upon assumptions not actually stated.

This is not the occasion to attempt a statement of a set of initial propositions for special relativity. But one may point out that, keeping to the class of ideas dealt with by Dingle, we must assume an observer to be equipped with some sort of "measuring-rod" and some sort of "clock". Now these must be *graduated*, and this introduces a problem not fully considered by Dingle as an essential part of the whole argument. He apparently supposes that the observer can regard a rigid measuring-rod as given, and can assume that the velocity of light, *in văcuo*, is constant. But these assumptions, taken together, permit a unique graduation of his clock. Conversely, the observer could regard a "uniformly-going" clock as given and, assuming the velocity of light to be constant, could derive a unique graduation of his measuring-rods. The choice between the two procedures seems to be not one of logical necessity; what is essential is that this matter of graduation should be given its proper place.

Passing to the second point, Dingle prefers to state results with reference to a single observer using various co-ordinate systems, rather than with reference to various observers. To some extent this is a question of convenience of description of the results. But in order to give a complete development of the subject without postulating more than one observer demands a deeper investigation than that given. For example, Dingle proposes (p. 23) to define length by a formula $l\sqrt{(1-v^2/c^2)}$, where l is what is usually called "proper length"; the question is, Who measures l? It is not sufficient to say that it is measured by the single observer who afterwards sets the body concerned in motion with velocity v, unless we add some postulates about accelerated motion and thereby transgress the usual scope of special relativity.

If Dingle is unprepared to base his revised formulation of the theory on an adequate set of postulates, it is hard to see what quarrel he has with current formulations. The answer to his objections would seem to be completely given by Prof. Campbell's letter in Nature (March 16, 1940) with, perhaps, added emphasis on the assumption that each observer graduates his scales and clocks in the above-mentioned manner, and that he can read the graduations used by other observers.

Beginners may fail to get a clear understanding of the theory from this book, though they are bound to find it stimulating. It is, however, assured of careful study by those having a special interest in this field. The reviewer wonders if they will share his conclusion—briefly this: All that special relativity claims to give is a better approximation than classical theory in dealing with some phenomena; it is admittedly inadequate in certain respects. So, leaving aside deeper questions of the nature of physical law, it is clear that we can scarcely have a *rigorous* deduction of special relativity from experimentally verifiable postulates. Any development of the theory must involve a tentative element to be judged on grounds of plausibility rather than rigour. Hence the choice of a formulation of the theory (as distinct from its application) is to a considerable extent a question of taste. Doubtless Prof. Dingle will not find himself alone in his particular taste in these matters.

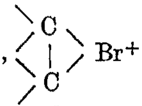
W. H. McCrea.

EXACT STUDIES OF ORGANIC REACTIONS

Physical Organic Chemistry:
Reaction Rates, Equilibria and Mechanisms. By Prof. Louis P. Hammett. (International Chemical Series.) Pp. x + 404. (New York and London: McGraw-Hill Book Co., Inc., 1940.) *26s.*

In the preface to this volume Prof. Hammett truly says: "It is one of the commonest occurrences in the development of science that the necessary subdivision of the subject leads to a temporary neglect of phenomena lying on the borders between specialised fields." Fortunately, both in Great Britain and in the United States this extreme specialization has not prevented chemists from recognizing that fundamental physical theories are quite as applicable to problems in organic chemistry as they are to studies of the simpler inorganic compounds. Chemical studies of reaction mechanisms can have little value unless they are developed from basic theories of molecular structure and statistical thermodynamics. These have been summarized logically in the first third of this volume and thereafter have been applied to the quantitative consideration of the majority of the well-known reactions of organic chemistry.

The majority of the reaction mechanisms discussed by Prof. Hammett were originally proposed by Lapworth, Robinson, Ingold and others in Great Britain, and it is evident to a British reviewer that many of the earlier suggestions were not, for some years, fully comprehended in America. Undoubtedly this delay in the dissemination of scientific theories has been due in great part to the plethora of ephemeral descriptive terminologies. To-day we need no groping qualitative descriptions, for the theoretical electronic basis of organic chemistry is now well established, and, as this book shows, can be presented in a readable, easily comprehensible, form.

Since an organic chemist has to concern himself with reactions occurring in solvents of all types it is necessary to generalize physical theories. Hence, as a unifying conception, the Lowry-Brønsted theory of acidity and basicity has been given its due place of predominance, and its wide quantitative applicability to reactions involving ionic substitution, acid and base catalysis, and molecular rearrangement has been shown. The 'transition state' conception, too, has been found to be invaluable in the discussion of the mechanism of complex organic reactions, and organic chemists will note with pleasure that the 'transition state' is frequently considered to be an ionized complex for which a definite graphic formula can be written. Among the more controversial of these graphic formulations are the postulation of a cyclic structure,  as an intermediate phase in the *trans*bromination of olefines, and the suggestion that the hydride anion, H^-, is a separable entity in the Cannizaro reaction of aldehydes. Suggestions such as these have been given strong logical support, and may be quoted as typifying the extent to which the author has been prepared to give prominence to his own considerable contributions to the development of organic chemistry. As a whole, "Physical Organic Chemistry" is both a valuable record of the present state of development of theoretical organic chemistry, and also a stimulating source of inspiration for future research work.

W. A. WATERS

HUMANISM AND LIFE

Our Human Truths
By the late F. C. S. Schiller. Pp. x + 371. (New York: Columbia University Press; London: Oxford University Press, 1939.) 15*s*. 6*d*. net.

THE late F. C. S. Schiller was one of the small group of Oxford tutors who some forty years ago or more won for a pragmatic philosophy a place in that University, and for a great part of his life he was among the foremost exponents of humanism. He was perhaps unique among philosophers in introducing into his work a strong seasoning of a somewhat Puckish humour, and his writings are illuminated from time to time by flashes of a mordant wit. In this volume are reprinted a number of pieces of philosophical and sometimes also of topical interest which were the recreations of the last years of his life, when illness enforced retirement from more active academic engagements. They have for the most part already appeared in philosophical, psychological or others of the periodical Press.

In these essays, classified under the headings of philosophy, literary criticism, philosophy in practice, political philosophy and logic, the practical bent of Schiller's mind is plainly discernible. For him philosophy—an empirical philosophy—was essentially and emphatically a way of life. As he argues forcibly in, for example, the two essays "Burning Questions" and "Must Philosophy be Dull ?" it was in the examination of such living problems as the nature of the self, which he regarded as the crux bequeathed by earlier philosophies from Descartes onward, that a future alone lay for these studies. So far was he averse from the logomachies of *a priori* schools, that he regarded their topics of discussion not only as arid, but also as fatal to the survival of philosophy at all.

In the section devoted to literary criticism, Schiller was particularly happy in his study "Goethe and the Faustian Way of Salvation", in which the exposition of the poet as philosopher and man of action combined afforded scope for his powers of critical and psychological analysis. It is, however, in its approach to the standing of science and scientific thought that his empirical philosophy assumes its most characteristic pragmatic attitude. Pure science, disinterested research, he regards as a late specialization in development, but science in its origins and throughout its history has developed from time to time in response to man's needs, material, intellectual and spiritual. Hence the principles and conclusions of science are not fixed and immutable but hypotheses of which the test value is not validity; but how far they are found to work, and to be scrapped and reformulated if necessary as experience and knowledge grow.

Schiller was strongly attracted by current questions of the social and international situation. It is interesting to see with how open and disinterested a mind he examined conflicting political systems in the light of his philosophy. Had he lived longer, matters upon which he necessarily suspended judgment in the totalitarian systems would probably have ceased to be open questions, though democracy on its side would not yet have purged its failures. On "The Crumbling British Empire" Schiller was early in seeing the full implications of the Statute of Westminster, which had been realized by few outside official circles at the time he wrote. Yet he recognizes that there are no precedents for the British Empire and suggests that if by some divine grace or lucky chance it can hold together by dint of mere sentiment, it may give a valuable lead to, and serve as a model for, the rest of the world. One question raised by him, in which he saw a possibility of dispute or at least of friction, namely, a declaration of war by the mother country, has been answered—happily.

THE POTATO AS FOOD

"THE United Kingdom has just had the largest crop of potatoes for many years, and unless the consumption is increased beyond the present level there will be a large surplus at the end of the season. . . . Potatoes are one of the best foods grown, for they are both energy-producing and protective." (*The Times*, January 15, 1941, quoting the Ministry of Food.)

One is perhaps prompted to query whether this forecasts an increased surplus over this year, when the tonnage of potatoes which the public will not be able to consume reaches almost astronomical figures. Moreover, what does this somewhat loose expression "energy-producing and protective" mean ? It therefore seems apposite to consider whether the discussion on the potato as food, which took place a few weeks ago, helps to assess the value of the potato ; the meeting was held under the auspices of the Nutrition Panel of the Food Group of the Society of Chemical Industry, and three papers were presented and discussed, concerned respectively with the biology (Dr. Redcliffe Salaman), the chemical constitution (Dr. L. H. Lampitt and Mr. N. Goldenberg), and the nutrition value (Dr. Harriette Chick) of the potato. All authors agreed on the importance of the potato as an article of diet ; but all three papers also indicated the lack of scientific knowledge and the desirability of well-planned and comprehensive experiments. This point was stressed particularly by Dr. Salaman and by Dr. Lampitt.

Dr. Salaman has made a detailed study of the history of the potato, and those who have read his various publications on this matter must recognize how much science owes to him for unravelling a very tangled skein. A proper understanding is essential if progress is to be made.

It is possible that the potato breeder is at the end of his tether in respect of improving the varieties from the available material, and one has heard with great satisfaction of the collection of potatoes at Cambridge made during the years immediately preceding the War from parts of South America, including the High Andes. One hopes that these experiments will not suffer the fate of so many Government schemes of research and be jettisoned on the score of expense. The importance to the potato breeder of new varieties, the introduction of 'new blood', cannot be over-estimated. If it is agreed that more potatoes still should be grown, the importance of virus-free seed has been amply demonstrated. Possibly the solution of the problem is not quite so simple as expounded by Dr. Salaman ; in fact, the Board of Agriculture appears (from one of the speakers in the subsequent discussion) to be somewhat sceptical of the virus-free theory. However, as a working hypothesis the advantage of stock not affected by the potato virus cannot be denied.

Moreover, it has already been pointed out that, with attention to peeling and 'eyeing', an increase of more than 33 per cent in potatoes 'ready-to-eat' is possible in Great Britain without increasing the acreage of land under potato crop ("The Nation's Larder"). Whilst it is recognized that the careful peeling necessary to achieve this increase is probably outside the scope of the housewife, an increase of 20 per cent should be capable of realization. Obviously, the greatest claim that can be made for potatoes is that they are home grown, and that valuable shipping space might be released if the amount of grain to be brought from overseas could be reduced. The $\frac{3}{4}$ lb. *per diem* for each head of the population would not be excessive. There are many countries where this figure is exceeded. An example is Germany, where for years previous to the outbreak of the War the use of potatoes was enforced as a diluent for wheat flour. It is, in fact, to the potato that Governments lead the nations when measures of economy are necessary.

This makes it all the more difficult to understand the paucity of basic knowledge on the chemistry of the potato. The variability of the tuber and the number of factors involved, make it essential that all experiments be planned on a large scale so that a statistical study can be effectively made. Some years ago an extensive investigation of certain factors was undertaken by the Rothamsted Experimental Station, and for two or three years previous to 1929.

It is a notable fact that the consumption of potatoes declines as the so-called 'standard of living' rises. Dr. Salaman thinks, too, that the craze of 'slimness in women' is a contributory factor, but our observations would lead us to suggest that this 'fear of the potato' is not confined to women ; many of those of the male sex who bow down to the god of physical fitness shun the potato.

The Potato Marketing Board had a most comprehensive study of the 'blackening' of potatoes in progress ; this investigation was abandoned, however, presumably as a measure of economy, a decision of a Government department that all should deplore, for in certain seasons this 'blackening' effect causes great loss to the nation.

The survey of the literature (*J. Soc. Chem. Ind.*, 59, 45, 748) with its reference to some 250 papers, seems to prove that very few of the statements that have been made have been definitely corroborated. It was pointed out that many of the observations recorded are either fragmentary or directed towards some isolated problem. The non-static character of the potato itself is to some extent responsible for the lack of uniformity of the results obtained. Variety, age and condition of growth are all major factors in the composition of the potato, and when to these are added the fact that the potato is not homogeneous, and that the greater number of workers have failed to state whether their analyses were conducted on peeled or unpeeled tubers, the chaotic condition of the data is to be understood. Lack of details of the method used in preparing a sample for examination is one of the most common failings in the description of much of the work on 'natural' products in the food world, and it is a point of interest that at meetings of the nature of the one in question, attempts to summarize present knowledge demonstrate the great importance of such elementary precautions.

Meetings of this nature are of importance, if only that in these times they make it possible for the 'fringe' scientific worker to evaluate the dicta, or even the advertisements of the Minister of Food.

Dr. Chick quoted figures which give some information relative to the 'energy-producing' value of the potato. 100 gm. of potatoes baked in the skins is equivalent to 113 calories, whilst 100 gm. of white bread is equivalent to 260 calories; in other words, the potato as prepared in this manner has a caloric value less than half that of the same weight of bread. Of the mineral elements, the importance of which in nutrition cannot be denied, potatoes are less effective than bread.

As 'protective' food, an important effect of potatoes is to provide or supplement the B-vitamins. Vitamin B_1 (aneurin) is probably present to an extent of about one quarter of that of wholemeal bread, for as Dr. Chick stated, the aneurin contents of potatoes and of wholemeal bread are approximately equal when the dry weights of the foods are taken into account. Unfortunately, little reliance can be placed on the scattered results in the literature concerning the other B-vitamins.

The importance of the potato as an antiscorbutic has also to be considered. The fact that scurvy has appeared in countries largely dependent on the potato for food, when the crop has failed, is a significant fact, and evidence was forthcoming in the discussion of the papers that the tuber is a necessary source of ascorbutic acid. If, however, full advantage is to be taken of the vitamin C content of potatoes, then the water in which the tubers are boiled should be consumed, for there is considerable loss of ascorbutic acid by diffusion into the water. Here the nutritionist and the gourmet are in agreement, for M. André Simon, who was chairman of the meeting, remarked on the value of the potato water in the preparation of soups and sauces.

DIET IN RELATION TO DENTAL CARIES*

BY PROF. E. V. MCCOLLUM,

JOHN HOPKINS UNIVERSITY

THE carious lesion in a tooth is caused by acid decomposition of the enamel, and afterwards the dentine, associated with proteolytic destruction of the organic substance of the tooth. Caries of the teeth is restricted to man and other animals which eat liberally of carbohydrate-containing foods. Carnivorous man and animals do not suffer from this disease. Dental caries does not attack the surfaces of teeth indiscriminately, but occurs only at such sites as favour the lodgment of food residues, as in pits or fissures, or on surfaces of the enamel which harbour mucinous plaques. In such sites acid is formed by fermentation of carbohydrate by micro-organisms, and is protected against being washed away by saliva or by neutralization by salivary alkalinity.

Throughout the Americas and Europe, and in most other temperate or torrid parts of the world, almost everyone eats liberally of carbohydrates, so the pabulum for feeding micro-organisms of every kind associated with fermentations is present in abundance at times in every mouth. Yet there is a great variation in the susceptibility of different people to dental caries. Numerous investigations have been devoted to attempts to discover why this great variation exists. Bunting and his associates, and Fosdick and his associates, have been foremost in studies of the microbiology of the oral cavity and its relation to caries of the teeth. A number of distinguished investigators have studied various aspects of the relation of the diet to susceptibility to this almost universal human affliction. I shall limit what I have to say to the nutritional aspects of this problem.

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* Substance of a paper read on September 18 at the Bicentennial Conference, University of Pennsylvania.

TOOTH STRUCTURE IN RELATION TO DENTAL CARIES

There is almost general agreement that potentially carious areas can be detected by a careful examination of the surfaces of the teeth. Dr. Thaddeus Hyatt, during his long tenure as chief of the dental clinic of the Home Office of the Metropolitan Life Insurance Company, directed his staff to explore the enamel surfaces thoroughly with a fine tine and when pits were found these were drilled and filled and the surfaces polished, thus eradicating potential food traps, or areas where stagnation and acid formation was likely to produce later carious cavities. This system of caries prevention is known as prophylactic odontotomy, and has been found effective by others as a means of preventing the disease. It is fully established, therefore, that developmental defects in the enamel may predispose teeth to decay.

FAULTY NUTRITION AND DEFECTIVE TOOTH STRUCTURE

Experimental work with animals has shown clearly several ways in which dietary deficiencies during the period of tooth development can impair tooth structure. One of these is vitamin A deficiency. In deficiency of this nutrient the epithelia, no matter how they are specialized, as in mucous membranes, glandular secreting structures, and skin, suffer changes in structure and in loss of physiological function. Keratinization and desquamation of epithelia find their counterpart in the enamel-forming organ of the developing tooth, in changes in structure and partial or complete loss of function. The enamel-forming organ is of epithelial origin, being derived from embryonic gum tissue. Each cell of this organ secretes calcium, phosphate, fluoride, magnesium, and carbonate ions in such a way as to cause them to combine and deposit in the form of tenuous enamel prisms. These prisms form a mosaic, which, in the normal tooth, is of great perfection. When, owing to vitamin A deficiency, the enamel-forming cells are injured, prisms which are less dense than normal, or incomplete as to length, and imperfectly fitted together, form defective enamel. In the milder grades of this type there are pits in the enamel. In more severe grades of injury, the surface of the enamel of the greater part of the whole of the tooth may be rough, the enamel thin and deficient in hardness. This is the hypoplastic tooth.

A second situation which may cause defective enamelling of the teeth is that seen in the disturbance of calcium and phosphate metabolism seen in the ricketic state. When the diet is complete as regards vitamin A and all other factors which are concerned with the promotion of healthy development, except vitamin D, the enamel-forming organ may be normal in every way, but be unable to withdraw from the blood the necessary structural materials for the formation of normal enamel. In rickets the concentration of phosphate ions in the blood falls below normal, and this interferes with the formation of sound enamel because the solution from which the cells derive their substances is too dilute.

Defects of enamel having their origin in disturbance of calcium and phosphorus metabolism have been most thoroughly studied by Lady Mellanby. She drew the conclusion from her observations that deficiency of vitamin D is of primary significance in predisposing teeth to caries susceptibility. The phosphate ion of the blood is maintained at normal concentration by the provision of this vitamin and, in addition to preventing defective bone growth, likewise has an important role in safeguarding the developing teeth against defects of structure. Lady Mellanby reported extensive experiments with children in Sheffield and Birmingham, all of whom were fed alike. To groups of these she gave generous prophylactic doses of vitamin D over a considerable period, and found that the incidence of dental caries was much lower in these groups than in the controls not receiving the vitamin. She expressed the belief that a diet highly favourable to normal calcification of bones and teeth could in considerable measure lessen the incidence of tooth decay.

McBeath, of New York, has carried out experimental studies with large numbers of school children over a period of several years, along the lines laid down by Lady Mellanby. He finds that there is a seasonal incidence of dental caries, the highest incidence of new cavities occurring in late winter and spring, and the lowest in summer and autumn. These observations he correlates with the amount of ultra-violet light which the children receive at different seasons. He further found that when liberal daily doses of vitamin D were given children during the colder months, the seasonal curve of incidence is flattened out, the incidence during the months of low sunshine being closely similar to that of summer and autumn. This type of experiment places vitamin D, for which suitable doses of ultra-violet light is the equivalent, in the position of playing a significant part in influencing the susceptibility of the individual to dental caries.

It is difficult to see how vitamin D can protect the teeth against decay merely by maintaining the body in a state favourable to calcification. Caries of the teeth occurs as the result of highly localized processes. In an area of stagnating food residues, acid is formed and protected against removal or neutralization, and is able to act more or less continuously in dissolving enamel. There appears to be no possible mechanism for resistance to acid erosion by enamel other than its density, which can be of but minor importance since the most perfect enamel is dissolved by acid when the pH reaches about 4·6, and the quality of enamel is not modified by any known agency after it is once laid down. If it is confirmed that sufficient ultra-violet light or of vitamin D favourably influences the body in its power to resist dental caries, it would seem that we must seek for an explanation in some effect upon the immunological mechanisms, which are of a nature to suppress the growth or functions of the microbial flora ordinarily associated with acid formation in the mouth. This might be exercised through the saliva or mucus, or other agency possessed by the epithelia. There do not appear to have been any studies recorded to test whether ultra-violet rays or vitamin D administration modify the oral flora.

That an immunity to dental caries may be artificially induced is suggested by the success of Bunting and Jay in preparing a vaccine from cultures of *Lactobacillus acidophilus* which they isolated from carious cavities. Upon intradermal innoculation of caries-susceptible persons there was a cutaneous reaction in nearly all cases, and when the test was applied to a series of caries-immune subjects, the skin reaction was almost always negative. There are in the population a considerable number of people who apparently eat as wide a variety as do most of us, and certainly eat freely of some form of carbohydrate, yet are caries-immune or nearly so. Some are immune to caries of the teeth during a period of years and then become susceptible. There seems much reason to attribute such immunity to systemic condition of some kind, and the most plausible explanation would seem to be an immunological one—the offending organisms find the mouth environment unfavourable because of the presence of something detrimental, and this something seems to be the product of the living tissues or glands accessory to the mouth.

EFFECTS OF EATING SUGAR ON CARIES INCIDENCE

The eating of sugar and sweets has long been popularly believed to cause the teeth to decay. This view is supported by the observations of Bunting and his co-workers, who, by means of dietary control, reduced the incidence of dental caries in an orphanage to a very low level. Upon permitting a group of children, whose mouths were free or nearly so of *Lactobacillus acidophilus*, and who were classed as caries-immunes, to eat about three pounds of candy per week, they found that they soon became caries-susceptible, and that the oral flora returned to the caries-producing type.

It is difficult to explain why eating sugar should be more likely to induce dental caries than cooked starch. Sugar is so easily soluble that it tends to be swallowed promptly as fresh quantities of saliva are secreted. Cooked starch, on the other hand, is pasty and is easily lodged in pits and fissures. Mixed with saliva and acid-forming organisms, starch would continuously undergo diastatic conversion into maltose, a fermentable sugar, thus furnishing an uninterrupted supply of nutriment for acid formation. Yet it is concluded by Bunting that this is not the case. Human experience confirms the findings of Bunting that people may eat freely of starchy foods and yet remain free from dental caries, or nearly so. An example are the people of the Island of Tristan da Cuhna, who consume potatoes as a staple food. The primitive Pacific Islanders, before the era of exploration, ate largely of starchy foods, yet they were almost free from dental caries. Sugar, therefore, seems on the basis of scientific observations now available, to be far more of a menace to the health of the teeth than are the starchy foods.

A dietary study of outstanding interest in relation to the caries problem was reported in 1926 and 1928 by Bodd and Drain, of the University of Iowa. They made repeated routine examinations of the teeth of the patients in the pediatric clinic over a period of some years, and encountered many teeth which had large cavities, which, ordinarily, would have an area of softened dentine surrounding the zone of destruction, but in these patients were found to have uncommonly dense and hard dentine walling off the cavities and arresting the progress of the carious processes. These cases of arrested caries, in which a secondary deposit of dentine had occurred, which formed an effective barrier against further invasion of the tooth, were found to be without exception diabetic patients. The arrest of dental caries appeared to have occurred as the result of their having been restricted to the low-carbohydrate high-fat type of diet now generally used by diabetic patients. This type of diet does not seem to have been further studied as a means of controlling dental caries, and is worthy of most careful consideration. If replacement of a considerable fraction of the carbohydrate moiety in our daily diets by fat will protect the population in great measure against dental caries, the fact should be made known, and such a diet recommended for non-diabetics.

But human experience appears to afford fairly numerous examples of peoples who in great measure escaped the ravages of dental caries, who did not eat low-carbohydrate high-fat diets. Chinese students in America appear to have a lower incidence of caries of the teeth than do persons of similar ages who have grown up in America. I have been repeatedly told by Chinese students that they experienced markedly increased incidence of tooth decay after spending a few years in the United States. The great majority of Chinese people have from very early times eaten freely of starch-rich vegetable foods. They eat various vegetable foods which have a detergent action on the teeth, which may be a factor of considerable importance in preventing stagnation areas.

Experimental studies on the effects of deficiency of ascorbic acid on the teeth indicate that the dentine-forming organ, the odontoblastic membrane, is peculiarly susceptible to injury in this deficiency state. The odontoblastic membrane lines the pulp cavity, and from its cells filaments (Tomes fibrils) permeate the dentinal tubules, which permeate the dentine to the base of the enamel. It seems certain that it is through the functioning of these fibrils that secondary dentine can be laid down near the outer border of dentine whenever irritation arises. This is a peculiar repair process, which, when the state of nutrition is near the optimum for calcification, can be called into being so as to arrest caries by a walling-off process. In this respect the perfection of function of the odontoblasts, which is influenced profoundly by the ascorbic acid supply, becomes an agency in the prevention of the extension of dental caries, but not of its incidence.

The fact which has been thoroughly established by the work of Bunting with institutional groups of children, all of whom were provided with the same food, is that there are individuals in whose mouths *Lactobacillus acidophilus* grows profusely, and forms the principal flora, whereas the mouths of other individuals contain principally organisms of other types. This would seem to demonstrate that the character of the oral flora depends greatly on conditions other than the character of the food eaten day by day, especially when a mixed diet, affording a fairly wide variety, is eaten. The most plausible explanation for the observed facts would seem to be found in the humoral defence mechanisms of the mucous surfaces, the mucous secretions of the saliva. We have one outstanding example of the relation between the state of nutrition and the character of the oral flora. At one time it seemed that Chittenden and associates at Yale University, and also Goldberger, in Washington, were dealing with the same state of malnutrition in their experimental dogs, both believing that the condition produced by their different faulty diets was the analogue of human pellagra. At Yale the dogs were cured by the administration of butter or boiled carrots, both of which are sources of vitamin A. At Washington, what appeared to be the same disease could not be cured by butter or carrots, but responded well to yeast administration, which did the dogs no good. In 1937 Smith and his co-workers at Duke University repeated both experiments and found that in the one case the dogs were in a severe state of vitamin A deficiency, and in the other of nicotinic acid deficiency. In both cases the earlier experimenters had depended greatly on the mouth condition for making their diagnosis. The oral flora in both groups of animals was of the fuso-spirochætal type seen in Vincent's angina. This is an abnormal and pathological mouth flora, and overgrows the oral cavity when the tissues are debilitated. It appeared in the dogs as the result of two quite distinct types of malnutritional deficiency states. In these two conditions the overgrowth of the mouth by a pathological flora would seem to be best explained on the basis of a lack of some humoral factor or factors which the normal mouth contains, and which serves to suppress the growth of certain abnormal types of micro-organisms. Perhaps the decided differences in the oral cultures found in many individuals may be accounted for on the same basis, namely, the failure of the oral structures to produce some humoral factor of immunological significance.

The recorded experimental data seem to warrant the acceptance of the following conclusions :

If the nutrition of the individual is optimal during the development period of the teeth, their structure will be safeguarded, and freedom from structural defects such as pits, fissures, hypoplastic enamel, may be expected. It would seem that dense, thick, hard enamel must afford some degree of protection against dental caries.

A state of optimum nutrition appears to afford marked protection against dental caries. It seems certain that such protection is in considerable measure due to some property of the mucous secretions or of the saliva or both, which tends to suppress the growth or functions of micro-organisms whose presence in large numbers would be inimical to the health of the teeth.

Subsistence throughout life on a strictly carnivorous diet will prevent dental caries. This would be impractical in most parts of the world, and if practicable, would be less satisfying than is a mixed diet. The presence of considerable carbohydrate in the diet is necessary for the development of carious teeth. There seems to be good evidence in support of the view that the regular consumption of a diet in which all the essential nutrients are present in adequate amounts, and in which the ratio of fatty acids to total carbohydrates (including the sugar which may arise from protein and glycerol) is not less than 1·5 : 1, prevents dental caries. This is equivalent to saying that a diet suitable for the diabetic is so constituted as to afford protection against dental caries, and even makes possible the arrest of the carious process in open cavities. This protective action of excessive fat in the diet may possibly be due to greasing the tooth surface and the cavity surface, thus waterproofing it and preventing access of water-soluble acids (for example, lactic acid) to the enamel surface.

There seems to be good evidence that the elimination of sugar from the diet, and the provision of carbohydrate in the form of starch, affords a less favourable oral medium for the development of acid-forming organisms, and so protects the teeth against acid decomposition.

It appears probable that the provision of an abundance of vitamin D, either taken directly, or derived from the action of ultra-violet rays on the skin, exerts a favourable action on the immunological mechanisms in the oral secretions or on the epithelia of the mouth, and makes for preventing the growth of excessive numbers of acid-forming organisms.

The dentist can supplement the protection against dental caries which right eating can give, by early eradication of potential sites of decay.

The food should always supply certain things which require vigorous chewing, since teeth which are not exercised do not retain optimum health. Every meal should end with some food such as raw fruit or raw vegetable, which requires thorough mastication, both because of the exercise afforded the teeth, and for the detergent effect of chewing foods which do not have a tendency to adhere to the enamel surface.

EVOLUTION OF DEVELOPMENTAL SYSTEMS

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THE theory of evolution is still the essential thread which connects together the numerous and diverse branches of biology. It has been clear at least since von Baer's day that a theory of evolution requires, as a fundamental part of it, some theory of development. Evolution is concerned with changes in animals, and it is impossible profitably to discuss changes in a system unless one has some picture of what the system is like. Since every aspect of an animal is a product of development, or rather is a temporary phase of a continuous process of development, a model of the nature of animal organization can only be given in developmental terms.

In recent times Goldschmidt has been the most prominent biologist who has attempted to describe biological organization in terms which are at once developmental and not too far removed from the genetical concepts employed by students of evolution. His great contribution to the topic was made by the publication in 1927 of his "Physiologische Theorie der Vererbung[1]". He pointed out that the development of an animal consists of a large number of correlated reactions proceeding at definite relative velocities; and he suggested that genes act by altering the rates of one or more of the reactions. This fruitful idea was successful in directing the attention of many geneticists to developmental problems, and has been the stimulus to much valuable work. It in no way diminishes the historical importance of Goldschmidt's theory to point out, after this lapse of time, that it is actually no more than the statement of the general notion of materialism in a four-dimensional world. So long as one considers development in material terms, there are only two things a gene could do: alter the velocity of a reaction (which includes arresting it completely), or initiate a new reaction; and the second of these can always be looked on as a secondary consequence of an alteration in the rate of some earlier reaction.

Before the theory can give us any specific picture of the kind of thing a developing animal is, it must be elaborated and restricted in such a way as to give it some concrete consequences. Goldschmidt attempted to do this by specifying a particular mechanism for the alterations in rate, which he suggested were caused by alterations in the quantity of gene material, which was thought of as acting in an enzyme-like way. Interesting as this suggestion is, it is not quite to the point so far as evolution is concerned. What evolutionary theory requires is not so much a hypothesis of the ultimate physico-chemical mechanisms of development, but rather a picture of the possible kinds of interactions between developmental processes ; it needs some framework of concepts in which it can discuss such questions as whether there is any difference in kind between specific and varietal differences.

I have recently[2] made some suggestions for an elaboration of Goldschmidt's hypothesis, which, it is hoped, will leave it general enough to apply to most, or all, developing organisms, but not so general that it applies equally well to the whole material universe. The most important of these suggestions can be summarized as follows :

(1) The course of a developmental reaction is the resultant of a large number of mutually interacting influences. If one plots a developmental process against time, one must regard the line as occupying a position of equilibrium, determined by a number of processes which tend to push it upwards and a number which tend to push it downwards. This notion might seem to be merely our old friend dialectical materialism rearing its head out of the shifting seas of metaphysical controversy. But it is more than that ; it follows directly from the experimental data concerning the effects of modifying genes, and of the general genetic background. It also issues in the following generalization from experience.

(2) In a normal animal, there are only a certain finite number of possible resultants of the interacting developmental processes. The final products of development, the adult tissues, do not, it seems, vary continuously from one type to another, but fall into a comparatively few tolerably sharply defined kinds. This implies that during development there is a succession of 'branching points', at each of which the course of development can move into one or other of a few alternative paths.

(3) One of the difficulties of an embryological theory has been to find a characteristic of a tissue which is causally connected with its future development. The classical concept of a potency is unsatisfactory because it is non-causal ; it merely allows one to describe whether or not a tissue does sometimes develop in a certain way. One can discover a characteristic of the required kind during a 'branch point'. At that time a tissue is in a state of indeterminacy between alternatives. This state, which I have called competence, is open to experimental investigation. It has the character of a readiness to react to certain stimuli (evocators), which may be applied either externally or, probably, from inside the cell. The future character of development depends directly on whether or or not such a reaction occurs.

(4) The definiteness of the alternative modes of development is a product of natural selection, and characterizes animals in the state of Nature. It is lost, or partially obscured, in most mutant forms.

(5) Other genes may cause particular regions of the body to enter upon a type of development which should characterize some other part. A clear example is the gene Aristopedia in Drosophila, which causes the arista (terminal section of the antenna) to develop in a leg-like manner.

Some, at any rate, of these points are adumbrated in Goldschmidt's writings ; but they have not been clearly realized by him. In his recent Silliman lectures[3] he is still concerned to show that time is the one and only essence of the matter. For example, he discusses the case of Aristopedia, and quotes his student Braun that the imaginal bud of the Aristopedia antenna becomes determined to develop into a leg at the same time as the leg buds are determined ; but he draws the completely unjustified conclusion that it is determined as a leg simply because of this temporal simultaneity. One might as well argue that because the neural plate and the epidermis of an amphibian become determined at the same time they must be determined to develop in the same way.

Goldschmidt's book is one of the most important of recent contributions to the theory of evolution. A very valuable feature of it is his masterly analysis of geographical variation, a subject in which his own researches have been of supreme importance. He presents considerable evidence that animals in Nature fall into groups between which there are 'unbridgeable gaps'. The groups may be small relict species or relatively enormous assemblages of intergrading forms. Their taxonomic treatment will be a matter of convenience ; but whether they are lumped as one species, or split up into a series of types each dignified with a specific name, is of minor importance in comparison with the essential fact of the existence of discontinuities between one set of intergrading types and the next. Evolutionary change within the group Goldschmidt names micro-evolution, while the arising of a new group separated from the old by a discontinuity, is macro-evolution.

A somewhat similar distinction has recently been made in the botanical field by Willis[4]. He suggests that the large groups arise by the working of "some definite law which we do not yet comprehend", and that then "evolution goes on in what one may call the downward direction from family to variety". Goldschmidt's view is somewhat similar in that he supposes that the evolution within the group merely brings about an increase in variability without producing any progressive evolutionary changes; but, unlike Willis, he allows that this micro-evolution is controlled by natural selection. His main criticism is directed, not at the theory of selection, but at the idea that macro-evolutionary change is dependent on genes. He is "firmly convinced that, except in micro-evolution, the facts already available to-day force us to drop completely from evolutionary thought the idea of so-called gene mutation, whatever it turns out to be physically or chemically".

It is remarkable to find that this very radical notion is advanced on almost exactly the same grounds as were used by the Mendelians of the beginning of this century to show that evolution does depend on genes. Goldschmidt is unduly preoccupied by the fact that the experimental and mathematical development of the theory of natural selection have been mainly concerned, for technical reasons, with the small-scale evolutionary differences which separate one variety from another of the same species. But it was exactly the existence of large discontinuities of variation which originally gave plausibility to the view that gene differences are important in Nature, and Goldschmidt brings forward no compelling new evidence for the rejection of this view.

One reason for Goldschmidt's distrust of genes as adequate building materials for species may be that his "rate concept" of gene action allows no place for differences in kind in the organisms produced; alterations in rate are essentially continuously variable. On the basis of the somewhat fuller theory given above, qualitative differences can easily be envisaged. According to that theory, the causal structure of an animal can be represented as a set of branching developmental paths, along each of which a certain part of the egg moves during its development. Changes in such a system would be primarily of two kinds: firstly, changes in the pattern or topological relations of the paths, which would imply an alteration in the distribution of the different portions of the egg between the various tissues, and, secondly, alterations in the actual course of the paths, which would imply that the final adult tissues were changed; and there might be combinations of these two kinds of change. Alterations of the first kind, which are typified by such a mutant as Aristopedia, would, I think, be reckoned as producing differences in kind, although it is always a matter of definition whether a change is taken as quantitative or qualitative. Differences of this sort have certainly played a large part in evolution on the grand scale, which gives rise to the major phyla.

The 'systemic' variations of Goldschmidt, that is to say the differences which separate the groups which are isolated by 'unbridgeable gaps', may also be of the second kind mentioned above. An alteration in the course of a developmental path will, if it occurs early in development, shift the whole set of paths which afterwards branch from it; that is to say, there will be a change in the character of a large number of tissues. This is the kind of difference which one most frequently finds as an 'unbridgeable gap'; it is a difference not in a few crude respects, but a permeating change in general facies. One finds genes which have similar effects within a species; for example, dachsous and rotund in Drosophila.

The 'unbridgeable' nature of the gap produced by such a gene can be understood in the following way. A developmental path has to be equilibrated; natural selection must build up a genetic background which stabilizes each path at the optimum. If, by an early-acting gene, a whole set of paths are thrown out of their old equilibria, a very considerable modification of the genetic background will be called for. Once accomplished, this will not be easily reversed or copied; and the new form will be effectively isolated from the old.

Goldschmidt's theory as to the causation of systemic variations is very unorthodox. He suggests that changes in the general pattern of an animal are caused by complex rearrangements of the chromatin. This may possibly be so, but it is a long shot in the dark. There is some evidence which seems to tell against both the essential features of such a hypothesis. In the first place some specific differences, such as that between *Drosophila melanogaster* and *D. simulans*, involve less chromosome rearrangement than may be found within a species. In the second place, there is no reliable evidence that the position effects caused by rearrangements produce more radical alterations of development than do normal gene mutations; in fact, most position effects are slight quantitative differences.

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[1] Goldschmidt, R., "Physiologische Theorie der Vererbung" (Springer, Berlin, 1927).

[2] Waddington, C. H., "Organisers and Genes", (Cambridge Univ. Press, 1940).

[3] Goldschmidt, R., "The Material Basis of Evolution". By Prof. Richard Goldschmidt. (Yale University: Mrs. Hepsa Ely Silliman Memorial Lectures.) Pp. xi+436. (New Haven, Conn.: Yale University Press; London: Oxford University Press, 1940.) 30s. net.

[4] Willis, J. C., "The Course of Evolution by Differentiation or Divergent Mutation rather than by Selection". By Dr. J. C. Willis. Pp. viii+207. (Cambridge: At the University Press, 1940.) 12s. 6d. net.

NEWS AND VIEWS

Prof. W. J. V. Osterhout

Prof. W. J. V. Osterhout has relinquished his post at the Rockefeller Institute in his seventieth year. One of the most prolific of contemporary writers on physiological subjects, Prof. Osterhout's name has been familiar to biologists since the opening years of this century. Many who associate Prof. Osterhout with problems of cell physiology may not be aware that his early interests lay elsewhere. During 1895–96 Osterhout studied in Strasburger's laboratory at Bonn and there investigated problems of nuclear cytology. Among Osterhout's contemporaries at Bonn were others destined for high place in botanical science: Prof. V. H. Blackman, recently retired from the chair of botany at the Imperial College of Science; Dr. R. A. Harper, who became professor of botany in Columbia University; and Dr. W. T. Swingle, who became a prominent member of the Bureau of Plant Industry, Washington. Those who knew him in these early days speak of the enthusiasm and zest with which Osterhout faced his life and work. These qualities have never flagged throughout a long career, and, even in retirement, we shall hope for more from his agile mind and ready pen. At the University of California, after contact with Jacques Loeb, Osterhout became engrossed in problems of cell physiology—problems which were to claim him for the rest of his very active career. Demonstrations that the then accepted facts of antagonism applied to plant, as well as animal, cells, and the development of quantitative methods for the measurement of cell permeability and the investigation of the factors which regulate this property, occupied him for many years.

Attracted by the possibilities for physiological investigation inherent in the genus Valonia, Osterhout contributed, in conjunction with a succession of research students and associates, a steady stream of papers on sap composition, salt accumulation, diffusion gradients across living membranes, bioelectric phenomena and on the investigation of diffusion and equilibria in various model systems so designed that they resemble special features of living cells. Confidence in physico-chemical interpretations of vital phenomena—in the tradition of Jacques Loeb—and a gift for ingenious experimentation, improvisation and interpretation, mark all the work with which Osterhout has been associated. These qualities were evident in one of his early books—"Experiments with Plants"—in which, in a manner still worthy of the attention of the teacher, Osterhout turned his attention to simple demonstrations of the essential facts of plant physiology. Prof. Osterhout has occupied teaching posts in the University of California and at Harvard. Many research students and post-graduate associates of Osterhout have attained prominence in American science, among them S. C. Brooks, M. M. Brooks, M. Irwin—who later became Mrs. Osterhout—L. R. Blinks and others. Latterly the claims of research ousted more general teaching. Since 1925, Prof. Osterhout has served the Rockefeller Institute, has been a trustee of the Wood's Hole Marine Biological Laboratory and a member of the editorial board of the *Journal of General Physiology*, in which much of his work is to be found. Future students of general physiology will not fail to see in Prof. Osterhout one of the outstanding figures of his day, and, as he relinquishes his post, his contemporaries wish him well.

University of Bristol: Air Raid Damage

The most serious damage to the University of Bristol during recent air raids was the loss of the Great Hall, gutted by fire. This hall, opened by the King in 1925, was a fine architectural feature with a hammer-beam roof and linenfold panelling of old English oak. With other buildings in the same block, it was the gift of Messrs. G. A. and H. H. Wills, and wood and stone carvers of the highest skill were brought from all parts of Great Britain for its construction. Since the arrival of King's College, London, the Hall had been used as a library and reading room for King's students, and the books it contained were all destroyed. A lecture room in the same building was also burnt. Another building which has been burnt out housed the anatomical dissecting room and theatre, portions of the Department of Geography and a unique collection of finds and exhibits of the Spelæological Society, which for many years has been active in the exploration of Mendip caves. The efforts of the A.R.P. guard, headed by Prof. C. M. Yonge, prevented fires from spreading to other departments. The roof of a new building to be used as an extension of the Library was burnt, but fortunately the University had not yet transferred any material into it. Other buildings, including the laboratories of physics and chemistry, suffered loss of windows by blast.

Bristol Museum and Art Gallery

The front part of the Natural History Museum, Bristol, which is an old building, has been entirely gutted by fire. The Geological Department was destroyed, but type specimens and much material in store were saved. Unfortunately, the fine collection of fossil saurian skeletons, especially those from the Lias of Street and Lyme Regis have been lost. The Zoology Department suffered considerably, but there is sufficient material left for reconstruction. Cases and contents in botany have gone, but some of the herbaria are intact. Cases and about half the contents, including glass and china, in the George Wills Hall have been destroyed.

An 1820 building which was the early home of the Bristol Institution and Museum and of the Literary and Philosophical Society was also gutted by fire. Humphry Davy contributed many lectures to the weekly series of the Society, of which Faraday and James Watt were honorary members.

Goldsmiths' College

GOLDSMITHS' College, which was severely damaged during a recent air raid, has an interesting history. The oldest part of the building represents what is left of the Royal Naval School, founded in 1833 as a public school to enable the less affluent naval officer to give his sons a sound education at the least possible expense. Nearly sixty years later the Goldsmiths' Company took over the premises, and established its Technical and Recreative Institute, providing, besides numerous technical classes, science and art departments which gained a high reputation. The latter attracted distinguished artists as teachers, whilst in the science department the late Sir William Pope, the late Prof. G. Barger of Edinburgh, and Prof. A. Lapworth of Manchester, were among those who gained their earlier experience in teaching. At the end of a period of thirteen years, the Act of 1902 having meantime thrown the responsibility for providing technical education upon the London County Council, the Company closed the Institute, and handed over the premises and site to the University of London on liberal terms. The University retained the Art and Science and Engineering Departments, and, with the co-operation of several county authorities, established a large Training Department.

Thus the Goldsmiths' Institute became Goldsmiths' College, owned and controlled by the University. The Science Department was closed during the War of 1914–18. Later on, the Engineering Department was removed to the new South-east London Technical Institute by the London County Council, and was replaced by an Evening Department of Adult Education. On the outbreak of the present war, the Training Department was transferred to Nottingham. As stated above, the College has been severely damaged. The upper floor, including the library and common rooms, has suffered very heavily. Fortunately, the Great Hall, capable of seating about 1,800 persons, and the organ, upon the renovation of which a sum of several thousand pounds has recently been spent, remain intact. The Art School, built at great expense only a few years ago, is also uninjured. It is to be hoped, therefore, that Goldsmiths' College will in happier times be enabled to resume its former activities.

Drug Supplies in War-Time

INSTEAD of the customary science paper, the January meeting of the Pharmaceutical Society's winter session, held on January 16, was devoted to the topical subject of the drug supply in war-time. The speaker, Mr. Arthur Mortimer, whose world survey of the medicinal products used in Great Britain —a survey prepared for use in the event of an emergency—has proved a helpful piece of work to Government departments, referred among other matters to drugs which are now scarce because their usual sources are no longer available, and to other sources of supply. It has been necessary, he said, to consider how far potassium salts can be replaced by sodium salts; the home supply of potash is very small and Great Britain has been mainly dependent upon Central Europe for its supplies, although since the War of 1914–18 arrangements have been made by British manufacturers to develop the Dead Sea deposits. It is obvious, he said, that for many uses sodium bromide can be as effective as potassium bromide. Regarding vegetable drugs he mentioned gentian, squill, liquorice, senega, cassia, belladonna, hyoscyamus, stramonium and colchicum, among others, which are already in short supply or may be in short supply, "though if care is used and substitutes are prescribed wherever possible, we shall have no difficulty in meeting the situation". Referring to the manufacture in Great Britain of synthetic products which in the past were made exclusively in what are now hostile countries, he said that H.M. Government naturally expects that every British pharmacist throughout the Empire "would refuse to keep enemy trade marks warm" and would do all they could to popularize the British remedies which are now available.

Polish Faculty of Medicine at Edinburgh

THE University of Edinburgh is providing facilities for the Polish Government to establish a Polish School of Medicine at Edinburgh. This will be staffed by professors and teachers now serving with the Polish Army in Great Britain and by professors of the University Faculty of Medicine in such subjects as may not be represented among the Polish staff. The Polish Forces in the country include a considerable number of medical men, of whom many are of high academic standing, and have held important teaching and research appointments in Poland. In addition, there are other medical graduates of Polish universities and Polish medical undergraduates whose work will be seriously affected unless something is done to mitigate the unfortunate situation in which these men now find themselves. As it is the proclaimed intention of Germany to abolish all higher education in Poland, that country will be left destitute of all means, human and material, for university teaching. By the formation of a Polish Faculty of Medicine, an important branch of Polish learning, namely, medical research and teaching, may be kept alive.

Concessions to School Certificate Candidates

CONCESSIONS to candidates for the 1941 School and Higher School Certificate examinations have been announced by the Board of Education. No abbreviation or reduction in standard of the syllabuses is demanded, but a wider choice of questions will be given so that candidates who, from unavoidable causes, have been unable to cover the whole ground, may yet have ample opportunity of showing their proficiency. The methods for conducting the examinations for admission to secondary and junior technical schools in 1941 will be the same as in 1940, and suggestions have been made for lightening the amount of work thrown upon education authorities in reception areas, whose staffs have already been depleted.

Overseas Students in Great Britain

IN the review of Mr. E. Child's book "The Tools of the Chemist" in NATURE of November 9, p. 604, reference was made to the necessity of bringing students from overseas to Great Britain after the War; and the suggestion was made that this should form part of the work of the British Council. Prof. B. Ifor Evans, Educational Adviser to the British Council, now writes that, since 1935, the British Council has been inviting students from overseas to undertake courses and research at British universities and similar institutions; indeed, had not the War prevented it, nearly 250 students from twenty-one countries would have commenced their studies in Great Britain in October 1939. Drawn from practically all countries of Europe, many countries of South America, the Dominions and Colonies and the Near and Middle East, these students would have studied or carried out research in a great variety of scientific and humanistic subjects, including medicine, engineering, agriculture, law, philology, economics, sociology, physics, education, English language and literature, etc. Such activity is continuing so far as possible, even during the War; last year 143 students from overseas studied in the United Kingdom under the auspices of the British Council, and after the War it is hoped to give a considerable extension to this work.

The American Contribution to a New Order

IN an address at Southampton, Long Island, on September 1 on "Our United States in this Backward Moving World", Dr. N. Murray Butler asserted that the human race is witnessing the greatest and most far-reaching revolution which history records. This revolution is primarily the outgrowth of economic problems and ambitions, and he urged that the substitution of information for knowledge as a result of the influence of the Press and the radio has made it of vital importance to look beneath the surface of things. The arrest at the beginning of this century of progress towards a prosperous and contented and peaceful world, organized for the preservation and protection of law and order, was due to the incompetence and failure of the democracies, especially France, Great Britain and the United States, to understand the new economic and political forces at work and to co-operate for their control and direction in a manner which would preserve and protect the democratic system of economic, social and political order, as well as the free institutions built upon that order.

In these critical years the democracies lacked conspicuously the able, constructive and courageous leadership required. Discussing the causes for the absence of co-operation, courage and vision in the democracies, Dr. Butler pointed out that all those important problems and policies which have been looked upon in the United States as national or domestic are now absorbed into and made part of the world revolution. This change must be recognized, as well as the danger incurred, for the public opinion and elected political representatives in the United States come under the pressure of closely organized and persistent minority groups, unconcerned with principles or the public welfare.

Public opinion, moreover, is the unseen product of education and practical experience. Education, in turn, is the function of the family, the church and the school in co-operation. The neglect or failure of the family in its guiding influence and discipline, and of the church in its religious instruction, has given an impossible burden to the schools, and these conditions must be corrected if the American people are not to play into the hands of the advocates of a totalitarian State. Dr. Butler further referred to the signs of an incapacity to understand and to interpret liberty, or to distinguish it from licence. The limit between liberty and licence must be recognized and observed if liberty itself is to remain. In this backward-moving world, however, Dr. Butler believes that leadership towards return to a new and forward-moving world may well rest with the United States. despite its shortcomings and failures. The federal principle it has established must be applied further if a new, prosperous and peaceful world is to be established upon the wreck of the present order.

Engineers and Reconstructions

AT a meeting of the Junior Institution of Engineers on December 14, Viscount Falmouth in his presidential address pointed out that, after the War, a heavy weight of responsibility will still lie on the shoulders of the engineer, for, though the planning of reconstruction may be in other hands, the methods and the actual work of restoring a stricken world will fall largely to the man of science and the engineer. When the Napoleonic wars left England and Europe in a state of profound exhaustion, it must have seemed impossible that recovery could take place for a long time. But depression lifted gradually, first in Great Britain and later in Europe, largely due to the development by James Watt of his steam engine. After 1918, Great Britain was again exhausted by the immensity of her effort; but although we had several severe economic storms to weather, yet, on the whole, our recovery was fairly rapid. Although this time we did not have an entirely new prime mover to come to our assistance, as we had in 1815, yet the years 1918–30 saw the large steam turbine reach a high state of efficiency and trustworthiness. This, doubtless, contributed to the national recovery. The fact that power from a thermal unit can be sold as cheaply as power from a hydro-electric station, has enabled Great Britain, with its small water-power resources, still to compete with countries better placed in this respect.

To-day we ask ourselves if there is any form of prime mover which is likely to do for our generation what the Watt engine did for the years after 1815 and the Parsons steam turbine did from 1918 onwards. Possibly the high compression internal combustion engine may be an answer. This has a high thermal efficiency, and, as now constructed, is most trustworthy. The fact that it can operate on either oil or gas without even changing the compression ratio gives it an important flexibility. Besides the assistance given to the world by the supply of cheap power in huge quantities after the War of 1914–18, the years since have seen a great development in the methods of manufacture. One lesson we must learn from the present War is that we must no longer neglect the manufacture of high-grade machine tools. The reasons are not necessarily technical; they are more in the economic field, but the high reputation we now have for very elaborate products should leave no one in doubt in the future that we can turn out small-grade machine tools of an excellent quality.

50-Million Volt Cyclotron to be Built in Moscow

THE construction of a very powerful cyclotron, capable of producing 50 million electron volt deuterons, will be commenced in Moscow early in 1941, according to a decision of the Academy of Sciences of the U.S.S.R., based on a report submitted by the Physical Institute of the Academy. A magnet the core of which weighs about 1,000 tons and solenoid of 18 tons is to be installed. A special building to house the cyclotron will be erected in the grounds of the new home of the Physical Institute of the Academy being built on the Bolshaya Kaluzhskaya Ulitsa in Moscow. The old apparatus in the Soviet Union, which is in the Radium Institute of Leningrad, is capable of giving an energy of 4 million electron volts to particles; another, nearing completion at the Physico-Technical Institute, also in Leningrad, will be capable of imparting an energy of 10–12 million electron volts.

Fossil Skeleton of Uintatherium

AN almost complete skeleton of Uintatherium, a six-horned animal the size of an elephant which dominated the primitive forests of southern Wyoming about thirty million years ago, has been found by Dr. Charles L. Gazin, palæontologist of the Smithsonian Institution. Bones of this giant mammal are common; but a skeleton with only a few parts missing is rare. Dr. Gazin's find lacks only one hind leg, part of a foreleg, and the neck vertebræ. The skull, about three feet long, is in exceptionally good condition, although the lower jaw is considerably crushed. There is also a second skull, including one of the beast's sabre-like down-pointed tusks about a foot long. The skeleton is expected to become one of the main exhibits in the U.S. National Museum, after it has been worked free from the matrix of hardened clay in which it is embedded, and properly mounted. This work may require as much as a year.

Recent Earthquakes

AN earthquake of considerable severity shook the island of New Britain, which is to the north-east of New Guinea, early on January 14. The epicentre appears to have been near Keravat, where houses collapsed. Keravat is some twenty-five miles from the port of Rabaul, where some faulting occurred, damaging the harbour. An earthquake of intensity 7 or 8 on the Rossi-Forel scale was felt at Rabaul on September 12, 1940, at 11.20 p.m. local time, the shock lasting for some three minutes and then decreasing in severity. Seventy-two distinct tremors were felt between then and 8.30 a.m. on September 13. The epicentre was judged to be about 70 miles south-south-east of Rabaul, and the shock was severely felt in the Kokopo District and at Wide Bay, Pondo, Namatanai and Buka.

On December 12 an earthquake was registered on the short-period instruments at Kew Observatory at 21h. 20m. 41s. G.M.T. There were only slight traces on the Galitzin seismograms. The earthquake was calculated to have had its epicentre some 290 km. distant from Kew and was thus a 'near' earthquake. About this time a shock was reported from Penrhos in North Wales. On December 28 a moderately strong earthquake, giving maximum ground amplitude of 21 μ was registered at 16h. 51m. 54s. G.M.T. It was calculated to have had its epicentre some 11,600 km. away and was thus a 'distant' earthquake. A full suite of well-registered waves was observed.

Announcements

SIR WILLIAM BEVERIDGE, who has been chairman of the man-power survey of the Ministry of Labour and National Service, has been appointed an under-secretary in the Ministry. It is stated that the man-power survey has been completed, and Sir William Beveridge will now have administrative responsibility for the section of the Ministry dealing with man-power requirements of industry and the Armed Forces.

MRS. NEVILLE-ROLFE, secretary-general of the British Social Hygiene Council, has been awarded the Snow Medal for 1941 by the American Social Hygiene Association. The medal is given for "distinguished service to humanity", and is named after Dr. Snow, the first director of the American Association, founded in 1913. Mrs. Neville-Rolfe is the fourth recipient of the medal and the first woman to receive it.

OWING to war conditions, the Industrial Health Education Society, which started its activities in 1927, has resolved to close down its work in arranging for talks on the requirements for industrial health. Its remaining funds are being handed over to the British Medical Association to establish a Mackenzie Lectureship on industrial hygiene in memory of Sir James Mackenzie, who began the work.

THE Clough Memorial Research Fund was instituted in 1935 for the purpose of encouraging geological research in Scotland and the North of England. The North of England is defined as comprising the counties of Northumberland, Cumberland, Durham, Westmorland, and Yorkshire. Under the terms of administration of the fund a sum of approximately £30 is available annually. Applications for grants are invited for the period April 1, 1941–March 31, 1942, and should be made to the Secretary, Clough Research Fund Committee, Edinburgh Geological Society, Synod Hall, Castle Terrace, Edinburgh, not later than March 1.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

The Protein of Insect Cuticle

Odier[1], Wigglesworth[2], Pryor[3] and others have demonstrated the presence of protein in the cuticle of various insects. The most modern study is that of Fraenkel and Rudall[4] using material from the prepupal and pupal stages of the blowfly *Sarcophaga falculata*. They showed that in the larval stage the cuticle contains a high proportion of a protein which is very soluble in water. On pupation more protein is added and the process of melanization is correlated with hardening, water loss and the loss of solubility of the protein.

TABLE 1.

Preparation	Total N. %	Ammonia N. % of total	Base N. % of total	Monoamino N. % of total
Sarcophaga larval protein	15·0	6·2	23·0	72·4
,, ,, cuticle	—	—	20·5	75·2
,, puparia	—	—	21·5	68·0
Sphinx ligustri protein I	15·1	8·5	19·5	73·0
,, ,, ,, II	11·4	—	—	—
Lobster cuticle protein	15·4	9·5	18·1	70·4
Sericin *A* (see Scott[5])		12·14	16·56	70·1
Sericin *B* (see Scott[5])		10·22	18·20	69·2

Since then I have been able to characterize the larval cuticle protein in *Sarcophaga falculata* and show its relation to the cuticle protein at other stages of the life-history and in other arthropods. Table 1 shows the nitrogen distribution in the preparations analysed.

TABLE 2.

Preparation	Tyrosine %	Tryptophane %	Glycine %	Sulphur %	Carbohydrate (as glucose) %	Amino sugar %	Phosphorus %
Sarcophaga larval cuticle ..	—	—	—	0·56	0·40	—	—
,, ,, protein ..	5·2	1·4	0·67	0·0	0·0	positive	0·0
Sphinx larval cuticle ..	—	—	—	0·30	0·81	—	—
,, ,, protein I ..	12·0	positive	1·32	0·34	0·0	0·0	0·0
,, ,, ,, II ..	—	—	—	0·51	2·86	positive	—
Lobster cuticle protein ..	6·0	positive	—	positive	positive	—	—
Sericin (Alders[6])	6·0	1·0	—	positive	—	—	—

Table 2 gives figures for specific components.

The general physical properties, nitrogen distribution and absence of sulphur suggested that the protein was similar to gelatin. However, the presence of considerable quantities of tyrosine and tryptophane indicated a marked difference (gelatin contains only traces of both amino acids) which is borne out by the very low glycine content. The tables show, however, that this and other arthropod cuticle proteins resemble sericin (silk gelatin) quite closely. This is understood, when it is remembered that the silk glands and the hypodermal cells secreting the cuticle are both epidermal in origin.

A study of the nitrogen distribution in the whole cuticle showed that both in the larva and the pupa the greater part of the non-chitin portion of the cuticle in *Sarcophaga falculata* is similar to the protein isolated from the larva. Observations on the melanin of the pupa substantiate the view of other workers that it is derived from tyrosine and is responsible for binding the chitin and protein together into a very compact and resistant complex.

Such proteins may be universal in the insect cuticle. Substances showing a general resemblance to the above have been obtained from a number of different arthropods, and figures are given in Tables 1 and 2 for those from the hawk moth (*Sphinx ligustri*) and the lobster.

The protein from Sarcophaga larvæ contains a trace of amino sugar but no carbohydrate or sulphur; though the intact cuticle contains small but definite quantities of both the latter. This suggests that there may be a carbohydrate-rich fraction in the cuticle other than the chitin itself. In this respect the hawk moth cuticle is similar; by extracting 'chitin' residues (after removing the very soluble protein I) with a more powerfully disrupting reagent it was possible to obtain a protein fraction II which contained amino sugar and was much richer in carbohydrate and sulphur than the whole cuticle. The chitin residue after this treatment had slightly lower than the calculated nitrogen content and contained no further protein, but still contained traces of sulphur and non-amino carbohydrate. The nature of the sulphur, which is combined, has not been definitely established.

The evidence supports the view that the carbohydrate and sulphur (possibly ethereal sulphate sulphur) are concerned in linking the protein to the chitin, which has, until now, been regarded as a neutral polysaccharide. It may now be tentatively suggested that the protein and chitin are linked in a similar way to that in the known mucoproteins (see Meyer[7]). It is interesting that Dr. K. M. Rudall (private communication), working on the same problem using X-ray analysis, now has evidence for a definite but weak chemical link between protein and chitin in the larval cuticle of *Sarcophaga falculata*.

This work suggests a chemical similarity between the chitin-protein complex of the insect cuticle and the known mucopolysaccharide-protein aggregates. It throws light on the problem of chitin formation, and shows that the cuticle is composed of components of the nature postulated from the properties of the cuticle now under investigation by Hurst[8] in his studies of insecticidal action.

This work was made possible by a grant from the Agricultural Research Council and has been carried out in the Biochemical Laboratory and the Biological Field Station of the Imperial College of Science and Technology. I am greatly indebted to Prof. A. C. Chibnall and to Prof. J. W. Munro for their continued interest and encouragement. I must also thank Drs. K. M. Rudall and G. Fraenkel for their interest and help.

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[1] Odier, *Mem. Soc. Hist. Nat.* (Paris), 1, 29 (1823).

[2] Wigglesworth, *Quart. J. Micro. Sci.*, 76, 269 (1933–34).

[3] Pryor, *Proc. Roy. Soc.*, B, 128, 393 (1940).

[4] Fraenkel and Rudall, *Proc. Roy. Soc.*, B, 129, 1 (1940).

[5] Scott, *Amer. Dyestuffs Reporter*, 28, 501 (1939).

[6] Alders, *Biochem. Z.*, 183, 446 (1927).

[7] Meyer, Cold Spring Harbour Symp., 6, 91 (1938).

[8] Hurst, NATURE, 145, 462 (1940); and private communication.

Permeability of Insect Cuticle

IN a recent communication[1] Hurst has described a series of important observations which go far to explain the action of non-toxic paraffins in facilitating the penetration of insecticides through the cuticle of insects. He provides evidence that "apolar substances of low dielectric constant" greatly increase the permeability of the outer lipoid layer of the cuticle.

I have recently obtained confirmation of this view in the following way. A small insect, such as a flea or louse, is immersed in oil and examined under the microscope. Within a few minutes if xylol is used, within half an hour or so if medicinal paraffin or olive oil is used, minute droplets of water begin to appear all over the cuticle; often most markedly on the hardest parts, such as the claws of the louse. Presumably polar substances of some kind crowd into the oil-water interface as the lipoid layer dissolves, and thus draw out the water droplets.

If such an insect is immersed in a mixture of ethyl alcohol and kerosene as described by Hurst, and watched under the microscope, the droplets swell up and separate with such violence that the insect seems to be effervescing. This, of course, is because in the presence of traces of water the alcohol separates from the paraffin. The same thing is seen, among other mixtures, in kerosene and acetone, carbon disulphide and ethyl alcohol, medicinal paraffin and butyl alcohol and, less violently, in medicinal paraffin and pyridine or dodecyl thiocyanate and pyridine. In benzene and ethyl alcohol diffusion currents appear over the cuticle but few droplets separate.

Besides substantiating Hurst's valuable discovery, these observations stress the importance of the partition coefficient of a substance between oil and water in determining the rate at which it will leave the oily base of a contact insecticide and enter the tissues of an insect. This simple conception may prove helpful for the rational selection of active principles and solvents in the preparation of contact insecticides.

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[1] Hurst, H., NATURE, 145, 462 (1940).

Sex-Ratio in *Urosalpinx cinerea*, the American Oyster Drill

IN the course of preliminary studies of the biology of the introduced American oyster drill, *Urosalpinx cinerea*, it was noticed that among drills kept in a tank at Conway a very large proportion of the medium-sized and large individuals deposited egg-capsules. This led to an investigation of the sex-ratio in this mollusc, the results of which are described briefly below. The sex of Urosalpinx is easily determined macroscopically, for the male has a comparatively large curved penis lying behind and slightly to the right of the head; in addition the gonad of the female is yellow or orange, while that of the male is whitish. Although Urosalpinx has been closely studied in the United States[1,2], no information is available concerning the sex-ratio.

Sex has been determined in a total of 1,946 drills belonging to sixteen samples dredged from the oyster beds in the Rivers Blackwater, Colne, Roach and Crouch. Of this total, 1,381 were females and 565 males, that is, females predominated to the extent of 71 per cent. In addition to this general preponderance of females there are also marked variations in the proportions of the two sexes in drills of different sizes. During the spring when the drills are spawning, there are about equal numbers of males and females among those with shells 2·3 cm. or less in height (Table 1); these drills can be stated with certainty to be one year old. It is doubtful whether the females deposit spawn at this age. Drills two years old are generally about 2·5 cm. in height during the spring, while three-year-olds average about 2·9 cm. Among these two- and three-year-old drills the percentage of females varies somewhat, but is generally between 60 and 70 per cent (Table 1). Drills more than 3·0 cm. in height at the beginning of the spawning season may be reckoned as four years old or more; among these large drills the percentage of females increases rapidly with height of shell and approaches 100 per cent. Males are very scarce among drills over 3·2 cm. but are not entirely absent. The largest drill examined was a female 4·3 cm. in height, but males between 3·5 and 3·8 cm. occur occasionally. Such very large drills must be at least six years old.

TABLE 1.—*Urosalpinx cinerea* FROM RIVER BLACKWATER, ESSEX, MAY 15, 1939.

Height	♀♀	♂♂	Total	% ♀♀
2·3 cm. and less	8	6	14	57·2
2·4 cm.	1	1	2	50
2·5 cm.	11	8	19	57·9
2·6 cm.	9	5	14	64·3
2·7 cm.	7	4	11	63·6
2·8 cm.	11	1	12	91·6
2·9 cm.	9	7	16	56·3
3·0 cm.	9	5	14	64·3
3·1 cm.	7	1	8	87·5
3·2 cm.	8	2	10	80
3·3 cm.	8	–	8	100
3·4 cm.	10	–	10	100
3·5 cm.	9	–	9	100
3·6 cm.	7	1	8	87·5
3·7 cm.	3	–	3	100
3·8 cm.	3	–	3	100
3·9 cm.	1	–	1	100
4·0 cm.	2	–	2	100
4·3 cm.	1	–	1	100
Totals	124	41	165	75·2

The percentages quoted above refer to conditions obtaining during the early part of the breeding season, which begins in late April or early May, reaches its peak during late May or early June, and thereafter declines in intensity. Whereas the percentage of females only slightly exceeds 50 per cent both before and after the spawning season, at its height in late May and during June the proportion of females reaches very high figures indeed, 95 per cent being obtained in one sample, while figures of 80–90 per cent are quite frequent (Table 2). The percentage of females therefore varies directly as the intensity of spawning, reaching a peak in June when most egg-capsules are deposited.

Many of the observed peculiarities in the sex-ratio would be explained if it could be shown that the oyster-dredge, by means of which the samples were collected, does not give an even sample of the population of drills, and that females are more liable to capture during the breeding season than males. It is known that the females tend to crawl on to raised objects on the sea bottom in order to deposit spawn, and therefore as the intensity of spawning increased more and more females would be found upon raised objects. It is, however, highly probable that the scraping bar of an oyster dredge collects practically everything in its path from the surface of the bed and not merely the most upstanding objects. Further, although nothing is known of the behaviour of the males during the spawning season, it is reasonable to assume that they follow the females. The constant high percentage of females among very large drills, even outside the breeding season, might be explained on the basis of sexual dimorphism, which is stated to occur in Urosalpinx in America, although the occurrence of isolated very large males (Table 1) is rather disconcerting.

TABLE 2.—SEASONAL VARIATION IN THE PERCENTAGE OF FEMALES IN SAMPLES OF *Urosalpinx cinerea* FROM THE RIVER BLACKWATER, ESSEX. ONLY THOSE DRILLS OVER 2·3 CM. IN HEIGHT, THAT IS, TWO YEARS OLD OR OLDER, ARE INCLUDED.

Date	♀♀	♂♂	Total	% ♀♀
7.4.38	50	42	92	54·4
10.4.40	12	13	25	48·0
2.5.40	66	46	112	58·9
15.5.39	117	35	152	77·0
15.5.40	243	33	276	88·0
13.6.40	57	3	60	95·0
14.6.40	124	18	142	87·3
20.6.40	31	22	53	58·5
2.7.40	80	28	108	74·1
15.7.39	122	58	180	67·8
26.8.40	54	37	91	59·3

For the reasons outlined above it is considered that an explanation of the peculiar sex-ratio in dredged catches of Urosalpinx, based solely on the possibility of a selective capture-rate during the breeding season, is unconvincing. An alternative explanation would involve actual changes in the sex-ratio due to sex-change in a part of the population both before and after the breeding season. This is by no means out of the question but is subject to experimental testing, for which an opportunity may be available next spring when the drills again become active following the winter period of quiescence.

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Dec. 20.

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[1] Federighi, *Bull.* U.S. Bur. Fish., 47 (1931).

[2] Galtsoff, Prytherch and Engle, U.S. Bur. Fish., *Fish. Circ.* 25 (1937).

Cytology and Taxonomy of Hebe, Veronica and Pygmæa

CYTOLOGICAL evidence has materially assisted towards clarifying taxonomic relationships in a large number of genera. As a rule, systematic and cytological approaches have led to conclusions which were in general agreement. Recent cytological work on the related genera Hebe and Veronica, however, pointed to a discrepancy between cytological and taxonomic evidence. This has now been removed by the discovery that the latter was based on erroneous observations.

Pennell[1], reviving Commerson's genus Hebe, separated it from Veronica L. Cockayne and Allan[2] transferred to Hebe the majority of the species endemic in New Zealand, but left in Veronica the group that Cheeseman[3] had placed in Euveronica. The species so placed by Cheeseman are confined to New Zealand, as is the large majority of the species transferred to Hebe. Pennell used the subspecies name Euveronica for a group within his circumscription of Veronica proper, with *V. officinalis* as the type species. The principal reasons for the retention of Cheeseman's Euveronica in Veronica were their manner of capsule dehiscence and the shape of their capsule, in both of which, following Hooker[4], the species grouped in Euveronica were held to be Veronicas rather than Hebes.

Frankel and Hair[5] found that the basic chromosome numbers of Hebe are 20 and 21. A large number of species was studied (Frankel, unpublished); without exception they range in two polyploid series, one more numerous, based on $x = 20$, the other on $x = 21$. The highest chromosome number is the hexaploid, $2n = 120$. Huber's[6] observation of $2n = 24$ for *H. diosmæfolia* is doubtless erroneous, its chromosome number being $2n = 40$. For those New Zealand species which were left in the genus Veronica, Frankel and Hair found $n = 20$ and $n = 21$. These chromosome numbers for Hebe and for Cheeseman's division Euveronica differ widely from those of the great majority of species of Veronica, including Pennell's Euveronica, with a main distribution in the northern hemisphere (cf. Lehmann[7]). They have, therefore a twofold significance. First, they support the establishment of Hebe as a separate genus, and second, they strongly indicate a close relationship between Hebe and Cheeseman's Euveronica, closer indeed than that between his Euveronica and any other section of Veronica. Yet, owing to its capsule being of the Veronica type, on taxonomic grounds this group had to remain in Veronica. Thus a clash appeared between the natural relationship as revealed by cytological evidence and distribution, and the taxonomic classification on morphological grounds.

In view of this contradiction, Allan[8] recently examined the capsule dehiscence of indigenous and introduced Veronicas. Whilst in the latter it followed along the lines described by Hooker, "in the New Zealand species placed by Cheeseman in Euveronica, . . . the dehiscence is essentially as in Hebe . . . the group thus occupies a somewhat intermediate position, but is much closer to Hebe proper than Euveronica (cf. Pennell)". Consequently Allan transferred the New Zealand species of Euveronica to Hebe. Thus in this case attention was directed by cytological data to a wrong classification which was due to erroneous observations.

The question must now be asked what should be the taxonomic position of the third group of New Zealand species related to Veronica, namely, Pygmæa. Founded as a separate genus by Hooker, reduced to a section of Veronica by Cheeseman, it received again generic rank from Cockayne[9]. The capsule characters of Pygmæa correspond to those of Hebe, its main distinguishing marks being its growth habit. All three species are small, depressed pulvinate herbs with minute, densely imbricated leaves all round the branches, and their corolla limb has five lobes instead of the four of Hebe. The chromosome numbers of two species, *P. pulvinaris* and *P. Thomsoni*, have now been established as $n = 21$, indicating again a close relationship with Hebe. It must be asked whether this obvious relationship in the 'genetic system' should not be expressed by the inclusion of Pygmæa in Hebe, whilst acknowledging its distinctiveness by the formation of a section of Pygmæa.

In cases such as this, cytological evidence is sufficiently convincing to establish taxonomic relationships which on morphological grounds alone are obscure.

OTTO FRANKEL.

Wheat Research Institute,
Christchurch,
New Zealand.
Nov. 14.

[1] Pennell, F. W., *Rhodora*, **23**, 1–41 (1921).

[2] Cockayne, L., and Allan, H. H., *Trans. N.Z. Inst.*, **57**, 11–47 (1926).

[3] Cheeseman, T. F., "Manual of the New Zealand Flora" (1925).

[4] Hooker, J. D., "Handbook of the New Zealand Flora" (1867).

[5] Frankel, O. H., and Hair, J. B., *N.Z. J. Sci. and Tech.*, 18; 669–687 (1937).

[6] Huber, A., *Jahrb. wiss. Bot.*, **66**, 359–380 (1927).

[7] Lehmann, E., *Cytologia*, Fujii Jubilee Vol., 903–919 (1937).

[8] Allan, H. H., *Trans. N.Z. Inst.*, **69**, 270–281 (1939).

[9] Cockayne, L., "The Vegetation of New Zealand" (1928).

Quantum X-Ray Reflection in Diamond

IT has been shown[1] that, corresponding to the usual formula,

$$2\,d \sin \theta = n\,\lambda \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

for the classical or unmodified reflection of X-rays, the general geometric law of modified or quantum reflection by crystals is

$$2\,d \sin \psi \sin (I + \varepsilon) = n\,\lambda \sin I \quad . \quad (2)$$

θ and ψ are here the glancing angles of incidence on the static and dynamic stratifications measured in the respective planes of incidence, ε is the angle between these stratifications, and I the inclination of the phase-waves of the lattice vibration to the static crystal planes. The two planes of incidence would coincide when the equations are simultaneously satisfied, and more generally also when the observations are made in a plane of the symmetry of the crystal. We may then write $2\,\psi = (\varphi + \theta)$ and $2\,\varepsilon = (\varphi - \theta)$, where θ and φ are the glancing angles of incidence and of quantum reflection measured with reference to the static crystal planes. The angle I in equation (2) is thus capable of being evaluated directly from observations of the Laue and the quantum reflections over a sufficient range of incidences. If I is $\pi/2$, equation (2) reduces to

$$2\,d \sin \tfrac{1}{2}\,(\varphi + \theta) = n\,\lambda \quad . \quad . \quad . \quad . \quad (3)$$

as a close approximation.

Careful measurements made by us of the modified reflections given by sodium nitrate, rock salt and calcite are in good agreement with equation (3). It may therefore be inferred that in these crystals, and probably also in ionic crystals generally, the phase-waves are transverse to the crystal spacings. Very early in our investigations, it was noticed that formula (3) fails to fit the observations on the 111 reflections of diamond. These are sharp and can be accurately measured, and, when φ and θ differ greatly, it is found that the observed values of φ are much nearer θ than those given by the formula. From a new series of measurements made over a wide range of incidences, we find that the observations fit the rigorous formula (2) perfectly, the angle I coming out as 55° ± 1°. This is half the tetrahedral valency angle, thus indicating that the phase-waves of the lattice vibration giving the modified reflections from the (111) planes of diamond are parallel to the (100) planes of the crystal lattice.

As has already been pointed out[2], the influence of temperature on the quantum reflections should be wholly different in the two cases $h\nu^* \gg KT$ and $h\nu^* \ll KT$, where ν^* is the frequency of the lattice vibration. The case of diamond belongs to the first category and we should accordingly expect that the intensity of the reflections should practically be unaffected by being cooled down to liquid air temperatures. Our experiments to test this point have been completed and completely confirm the theoretical expectations.

C. V. RAMAN.
P. NILAKANTAN.

Department of Physics,
Indian Institute of Science,
Bangalore
Nov. 11.

[1] Raman and Nath, *Proc. Ind. Acad.*, 12, 83 and 427 (1940).

[2] Raman and Nilakantan, *Proc. Ind. Acad.*, 11, 396 and 406 (1940).

'Historical Materialism'

IN the notice of Dr. Federn's recent book "The Materialist Conception of History" published in NATURE of November 9, the reviewer, while deploring the interest of "the non-historical younger part of our people" in historical materialism, sums up his own attitude, and that of "generations of better historians than Marx". in the statement that "mind and not matter rules the world". If this is meant to imply that mind or the human will can act as an independent agent, then it is in striking contrast to the attitude expressed by Prof. Einstein in his article on "Science and Religion" in the same issue of NATURE. In discussing the "regularities obtaining within the realm of living things", which presumably includes human history, Prof. Einstein says, "For him [a man imbued with the ordered regularity of all events] neither the rule of human nor the rule of Divine Will exists as an independent cause of natural events."

The opinion of Marx and Engels on this question was clearly expressed in a letter from Engels to J. Bloch[1]: "We make our own history but in the first place under very definite presuppositions and conditions. Among these the economic ones are finally decisive. But the political, etc., ones and indeed even the traditions which haunt human minds, also play a part though not the decisive one."

I believe that the attitude expressed in the above quotations commands a great deal more sympathy among the younger men of science and even historians than the purely idealist position of Mr. Marvin. At the present time, when everyone is deeply concerned to understand the forces behind contemporary history, and events themselves are forcing us to attempt to analyse society, historical materialism deserves a serious evaluation.

C. F. POWELL.

52 Kingsdown Parade,
Bristol.

[1] Selected Correspondence (Martin Lawrence), p. 475.

Cultural Significance of Science

THE admonition in NATURE of December 28 to abandon "once and for all the belief that science is set apart from all other social interests as if it possessed a peculiar holiness" expresses very precisely the opposite of what many men of science consider to be their duty. I, for one, can recognize nothing more holy than scientific truth, and consider it a danger to science and to humanity if the pursuit of pure science, regardless of society, is denied by a representative organ of science.

For the last ten years we have been presented by an influential school of thought with phrases about the desirability of a social control of science, accompanied by attacks on the alleged snobbishness and irresponsibility of scientific detachment. The 'social control of science' has proved a meaningless phrase. Science exists only to that extent to which the search for truth is not socially controlled. And therein lies the purpose of scientific detachment. It is of the same character as the independence of the witness, of the jury, of the judge; of the political speaker and the voter; of the writer and teacher and their public; it forms part of the liberties for which every man with an idea of truth and every man with a pride in the dignity of his soul has fought since the beginning of society.

This struggle is to-day at its height; on its outcome will depend, among other great issues of a kindred nature, whether scientific detachment and the civilization pledged to respect and cultivate pure science shall perish from this earth.

M. POLANYI.

The University,
Manchester.
Dec. 30.

Science and Government

ARTICLES have recently appeared in NATURE referring to what life ought to be like after the war. Other journals have also discussed the same subject. Each writer, theologian, socialist or whatever he is, feels sure that there will be a change and that his views will then get due recognition. All may agree that after this great conflict we shall not settle down again into the same old ways. Let us hope that science may then come into its own.

There was a time when 'science' was 'falsely so called'—that time has passed with the Dark Ages. Then came the twilight of the Renaissance. Now we are living in the daylight of the new day which has dawned on the world. The pious guesses and folk-lore of the past—to be revered as showing the stages of human evolution and inspiration—must now be replaced by the certainties and accuracies of science.

For a hundred years success has attended engineering and chemical enterprises which were guided by scientific methods, and what is urgently required is that science shall control not merely our factories but gradually all activities which come within its ambit—efficiency and economy being the objectives. Instead of party government we require scientific government. Thus may science prove the unifier of man, and usher in an era of universal peace. Individual health and happiness will also be secured by the application of scientific principles. But how can science obtain the control to which it is entitled?

ROBERT H. F. FINLAY.

Victoria Square,
Belfast.
Dec. 10.

RESEARCH ITEMS

Early House-Types in Wales

Examination of a croft site, Nant-y-Moch, in the Upper Nedd (Neath) valley, Ystradfellte, Brecknockshire, has led Sir Cyril Fox to certain conclusions as to possible prototypes of the Long-House in Wales (*Antiquity*, December 1940). The site lies at a point in the valley 1,250 ft. above Ordnance datum in an upland region such as was much sought after by early man, and where, it is known, was a meeting place of the *B* (Wessex) and *A* (East Anglian) Beaker cultures. The house stood on a narrow shelf, its long axis being at right angles to the contours and the upper part deeply excavated in the side of a rapidly steepening hill. It is in ruins, and certain structural features are obscure. It is built on an artificial platform on two levels, of which the upper end is much below, and the lower end slightly above, the natural level of the natural surface. Probably the length of the upper half was not less than 20 ft., the breadth only 12 ft., but at the southern end increasing to 17–18 ft. with a roof span slightly in excess. The total length was probably not less than 55 ft. A cross-wall divides the upper and lower houses. The excavation into the hillside is horseshoe-shaped and revetted rectangularly. The lower house is stone-walled. It belongs to the group of "long-houses" of which the essential features are a cowhouse under the same roof as the dwelling-house, and usually at a lower level with direct communication by means of a passage. Such houses are still numerous in Carmarthenshire and afford close parallels. A striking feature is the construction of the dwelling on a tilt. The earlier are structurally single. The change from excavated area to platform corresponds with the division between the upper and lower houses and the entrance to the upper house. Nant-y-moch is probably a long-house embodying features not hitherto recognized as elements of the type; and it may prove to be the prototype or one of the prototypes of that house in Wales.

Apache-Pueblo Culture Elements

Investigation of the culture elements of the Apache-Pueblo group of the south-western States in the series of culture element distribution studies being made under the auspices of the University of California was carried out in 1935 by E. W. Gifford (*Univ. California Anthropol. Rec.*, **4**, 1; 1940). The material is largely Athabascan, 13 out of 20 groups belonging to this linguistic family. Of the remainder, Piman was represented by Papago, and four were Puebloan, namely, Shoshonean, Zuñian, Keresan and Tanoan. From analyses of the elements observed it emerges that there is a number of universal elements present in all 20 groups which may be regarded as fundamentals of south-western culture. At least 2 per cent of the 2,990 (or, when thoroughly atomized, 6,000) elements are universal to the groups in the region. The 'qualitative' analysis largely supports current opinion as to the relationship of various groups. For example, the Western Apache stand out as not at all acculturated to Plains culture pattern, while their eastern relatives are increasingly so acculturated the farther east one goes. The Navaho appear much more strongly tinctured with Pueblo traits than do the Apache, yet they have a fair number of specialities which set them off from other Athabascans and south-westerns. The Puebloan groups have an extensive common foundation of unique elements. From the statistical analysis of A. L. Kroeber it would appear that the Puebloans form a well set-off group in spite of their internal speech diversity, their closest external relation being Zuñi-Navaho, with Hopi-Navaho next and Tanoan-Jicarilla third. Of the four Athabascan groups, Navaho, Western Apache and Jicarilla constitute cultural sub-groups of some historic depth. The Navaho are far from uniform internally, and eastern and western differ more from one another than any of the five Western Apache who form a closely knit group. The Jicarilla resemble Eastern Apache more than they resemble Western or Navaho. The Eastern Apache are an artificial group; while Papago and Southern Ute fail to show strong similarities with either Pueblo or Athabascan and, therefore, are not "South-western".

Physiological Aspects of Lactation

At the present time, when milk is an article of diet so much in the public eye, the review of the various physiological aspects of lactation by S. J. Folley (*Biol. Rev.*, **15**; 1940) has an added interest. In it the author epitomizes the work that has been done to date on different mammals on this subject, from the endocrine, nervous and biochemical points of view, and, of course, provides an extensive bibliography. In most species œstrogens stimulate the growth of the ducts, but in the guinea pig and goat they also produce alveolar development. In some species growths of both ducts and alveoli are influenced by androgens. The anterior pituitary plays an important part in various activities connected with lactation, and some workers believe that it produces a specific lactogenic hormone. The adrenal-cortical hormone is also essential for lactation, since the removal of the cortex results in the cessation of this activity. There are no true secretory nerves, though the extirpation of the sympathetics disturbs lactation. Lactose is synthesized from blood glucose, milk fat derives from the neutral fat of the blood; but it is improbable that the milk proteins are produced from the amino-acids in the blood. Caseinogen is probably built up from the plasma proteins.

Chromosome Studies

The discovery of the banded giant chromosomes in the cells of the salivary glands of some, but not all, of the Diptera provided a new starting-place for various types of cytological research. T. S. Painter (*J. Roy. Micro. Soc.*, **40**; 1940) has reviewed the results to date from the points of view of the structure of the chromosomes themselves, experimentation upon them by physico-chemical means, and their utilization in hybrids, geographical races and closely related species to estimate what part is played by differences in gene alignment in the formation of races and new species. The bands are made of chromomeres, generally vesiculate, connected by pro tein strands. The chromosomes represent completely uncoiled prophase chromosomes which have undergone a number of longitudinal divisions producing a multiple strand, a polytene. This condition is actually one of polyploidy in which the chromosome strands remain permanently associated instead of forming separate units. Polyploid nuclei with polytenes have been demonstrated in the cells of the mid- and hind-gut of mosquito larvæ and pupæ and in other parts of other insects. Their large size and the constancy of the band pattern have permitted the experimental deletion of relatively limited regions and in this way a localization of certain genes to a definite band. In species allied but with the same chromosome number, realignments of the bands are found.

A Giant Hydroid

THE giant among hydroid polyps is undoubtedly the Japanese deep sea form, *Branchiocerianthus imperator*, one of the Corynorphidæ, with a length of 2,235 mm. Recently, another hydroid has been discovered in shallow water off the Argentine Islands by the British Graham Land expedition, which, while only 850 mm. long, is easily the next in size. It is *Myriothela penola*, and is fully described together with another new species of the genus, *M. capensis*, from East London, South Africa, where it was collected by Prof. Stephenson and Miss Eyre, in a paper by S. M. Manton (British Graham Land Exped., Sci. Rep., 1; 1940). This, the second largest hydroid, belongs to the Myriothelidæ, and one of the differences between it and the largest is that in *M. penola* there is no hydrocaulus, so that the length is all body, whereas in *B. imperator* the bulk of the animal is hydrocaulus and the actual hydroid body is only about 40 mm. It is probable that the large size in these two not closely related animals is attained by continuous growth from recognizable growth-zones and a consequent absence of specific size. *M. capensis* is by comparison only a midget, for it measures 17 mm. In spite of this enormous difference of size, the nematocysts are only a little smaller in the smaller species and are of the same four types. Those of the British *M. cocksi* are intermediate in size, being, like the animal itself, slightly larger than in *M. capensis*. Both new species are bisexual. In *M. penola* transportation of the enteric fluid is brought about by ciliated grooves lying between the close-set villi of the blastostyle, and binucleate cells, only rarely met with in the animal kingdom, occur in the endoderm.

Variation in Fossils

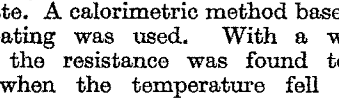
MUCH excellent work has been done in studying the variation in fossils belonging to a single assembly of more or less contemporaneous individuals. But there is a more important problem, namely, to compare closely allied assemblages belonging to different generations, and so to assess the part played by variation in evolution. This is the principal subject of the presidential address delivered on March 13, 1940, by Prof. H. H. Swinnerton to the Geological Society of London (*Quart. J. Geol. Soc. Lond.*, 77, 96; 1940), and he explained some methods he had devised for this problem. The usual method of comparing one fossil with another by eye is too much dependent on the personal element. For measurements upon single features, or two features of which one is expressed as a percentage of the other, the usual statistical frequency curves can be used. The real difficulty arises when three components are considered. Scatter diagrams were used by Day and afterwards applied very extensively by Trueman; but if we try to compare one scatter diagram with another, as is necessary in comparing an ancestral community with a community derived from it, we get an almost hopelessly confused mass of dots. Prof. Swinnerton's method is to draw a polygon (the 'scatter periphery'), and to draw two 'median lines', one parallel to each co-ordinate axis, each of which divides the number of dots into two equal parts. We may also draw the 'limiting frame', that is, the smallest rectangle with sides parallel to the co-ordinate axes which encloses the scatter periphery. Superposition of two such scatter peripheries, with the accompanying median lines and possibly the limiting frames, enables one to make a rapid comparison of two assemblies, and to draw certain general conclusions. The large proportion of comparable combinations which each descendant assemblage has in common with the ancestral assemblage becomes apparent, and the remarkable stability of the communal heritage.

High-Frequency Resistance of Superconducting Tin

IN the issue of the *Proceedings of the Royal Society*, A, of November 27, 1940, H. London reports experiments carried out in Oxford and Bristol on the high-frequency resistance of tin in the superconducting state. A calorimetric method based on eddy-current heating was used. With a wave-length 20·5 cm., the resistance was found to decrease *gradually* when the temperature fell below the transition point instead of showing the characteristic *sudden* drop in resistance to direct currents. Good agreement between experiment and theory, based upon the simultaneous presence of normal and superconducting electrons, was found. Absolute measurements of the conductivity in the normal state at low temperatures with both high and low frequencies showed that, at the temperature of liquid helium, the conductivity for high frequency is considerably lower than for low frequency. In explanation, it is suggested that the mean free path of the electrons becomes larger than the penetration depth due to skin effect under the conditions of high conductivity and high frequency.

Synthesis of Cannabinol

IT has been suggested that cannabinol, a constituent of the resin of *Cannabis indica* first isolated in 1896, is 6″-hydroxy-2 : 2 : 5′-trimethyl-4″-*n*-amyl-dibenzopyran:



and this has now been confirmed by R. Ghosh, A. R. Todd and S. Wilkinson (*J. Chem. Soc.*, 1393; 1940) by synthesis. In this, 6″-acetoxy-2 : 2 : 5′-trimethyl-4″-*n*-amyl-3′ : 4′ : 5′ : 6′-tetrahydro-dibenzopyran was dehydrogenated with palladized charcoal, and the almost colourless resin, with the composition stated, was found to be identical with cannabinol, a constituent of Indian and Egyptian hashish. This was confirmed by comparison of its acetate and *p*-nitrobenzoate with the corresponding esters of the natural material.

POWER AND COMBUSTION

PROF. A. C. G. EGERTON delivered the twenty-seventh Thomas Hawksley Lecture of the Institution of Mechanical Engineers on November 15 last. At the outset, he emphasized the fact that the sun is the source of practically all power on earth. Its surface (photosphere) has a brightness temperature of 6,000° C., and radiates energy at the rate of $3 \cdot 8 \times 10^{33}$ ergs per second. This radiant energy works a great engine of $2 \cdot 3 \times 10^{14}$ h.p. wherein the sun is the furnace, the atmosphere is both working substance and cylinder, and space the condenser. Within the workings of this engine potential energy is being converted to kinetic; kinetic back into potential. Approximately 35 per cent of the energy of radiation is used in evaporating waters of the ocean and the land. On condensation the energy is released: some returns as kinetic energy of the rain or the rivers; some appears in the wind and thunderstorms.

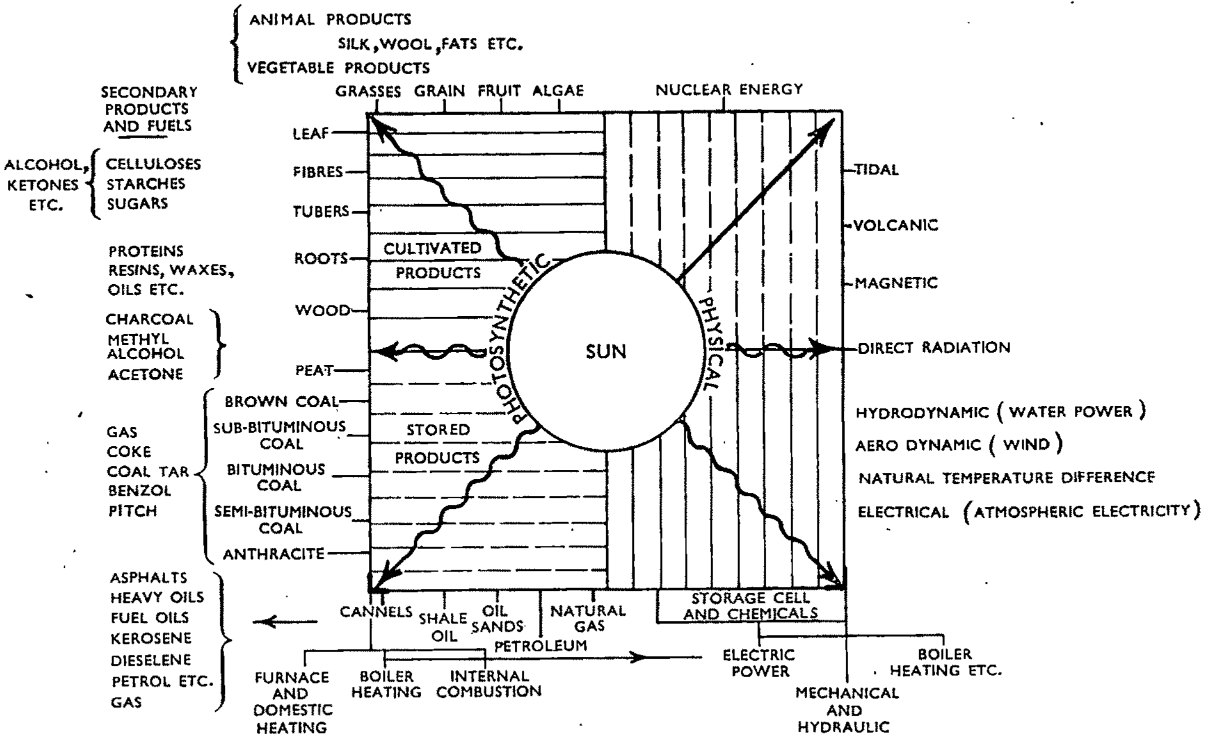


Fig. 1. [*By courtesy of the Institution of Mechanical Engineers*

Tidal power, which is mainly derived from the gravitational effect of the mass of the moon, also falls within the whole scheme of solar energy, for the moon was born of the earth. Volcanic power represents the energy remaining of that with which the earth was originally endowed by the sun and is maintained by the sun's radiant energy, which prevents further cooling. Atomic energy, or the conversion of the matter of the earth into energy, is now an enormous source of potential power, and should it become available as a result of the artificial fission of uranium, it will also represent part of the energy derived from the sun, since the earth was born of the sun. Energy might also in theory be derived from any region where differences of temperature are maintained by natural means; for example, the lower and upper layers of tropical seas. The energy of lightning might be harnessed, but its total contribution throughout the world would be small.

At this point in his lecture Prof. Egerton examined the nature of power and pointed out that there are two kinds: the power that drives, and the power that directs. Human beings are able to direct the activities of Nature and thus obtain power from the effects of the sun on the atmosphere. There is, however, another factor which is capable of directing power, and that is plant life. Photosynthesis takes place within the cells of the plant as the result of the utilization of radiant energy falling on its surfaces. The products of photosynthesis are valuable sources of power. The origin of coal is certainly vegetable, and the origin of oil is, according to the author, almost certainly mainly vegetable.

Fig. 1 serves to summarize the various sources of power discussed by Prof. Egerton. The section shaded with broken vertical lines indicates physical sources dependent on solar radiation and utilized mainly by means of hydro-electric stations. The section shaded with full horizontal lines refers to the products of photosynthesis. The section shaded with broken horizontal lines indicates those products which have gradually been stored throughout geological time.

The two main sources of power are hydro-electric power and power from stored fuel. The latter has the advantage that the energy can be transported where it is needed.

After an admitted digression which included discussion of some interesting problems of combustion, ignition of hydrocarbons, 'knock' and treatment of petroleum, Prof. Egerton returned to the main theme of his lecture and summarized conclusions reached by means of a diagram of human activities (Fig. 2). Starting from the centre, solar radiation provides stored and cultivated products. The energy value of the foods produced would be less than a tenth of the fuel produced, but the gold value of the foodstuffs is far greater than the value of all other production. Food provides energy for the worker, and fuels supplement his work. In this way the energy is as it were 'up-graded' in order that exchange may be made for food. In the process of keeping the mechanism of the body in action, food energy is 'down-graded'. Waste in either the 'up-grading' or 'down-grading' process should not be tolerated if the best use is to be made of radiant energy. Other essentials of life besides food and water include clothing, shelter, warmth and rest. Some of these are obtained through fuels, others through treatment of agricultural products. Sometimes the agricultural product is broken down; sometimes it is preferable to build up from the fuel.

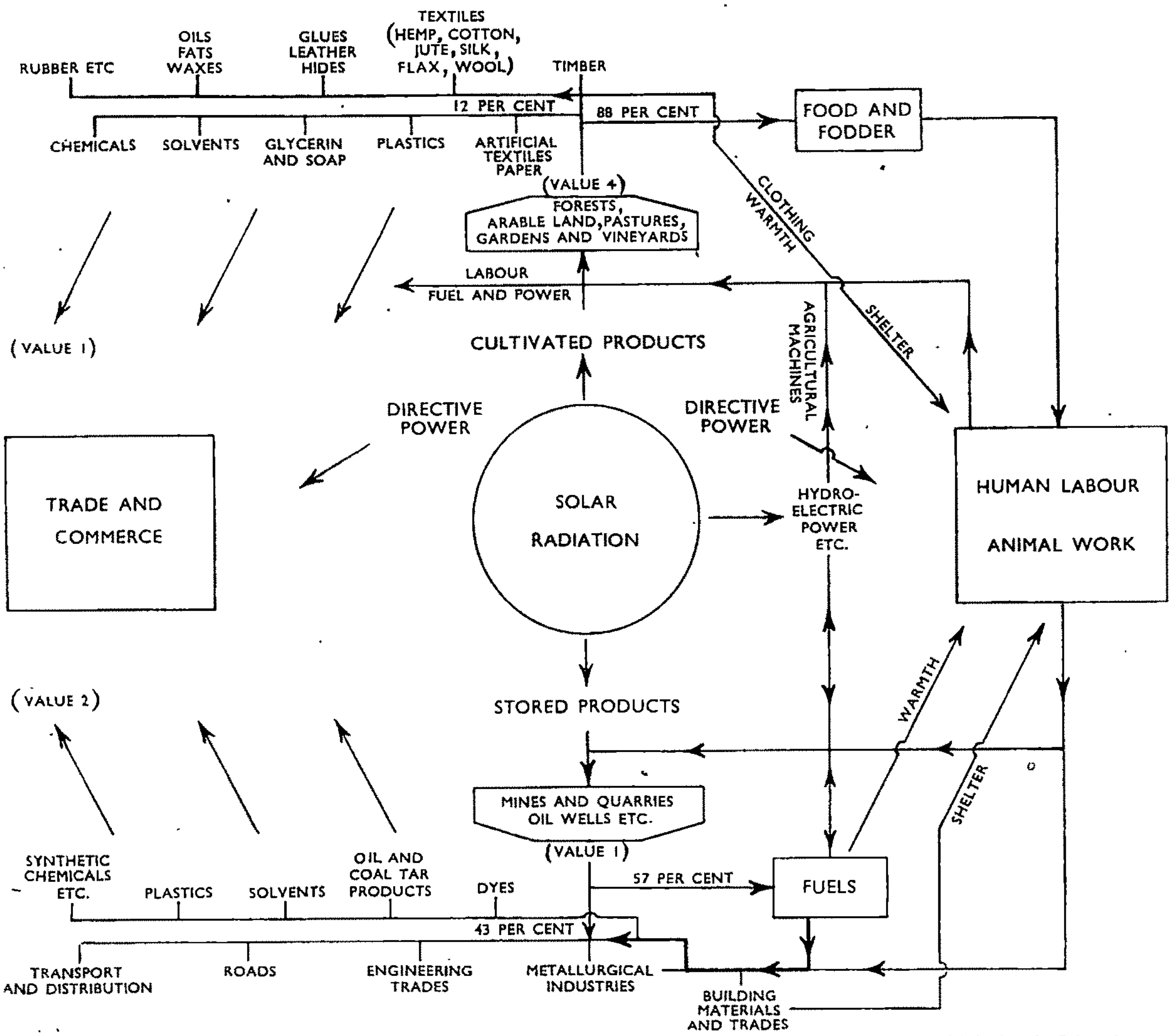


Fig 2. [*By courtesy of the Institution of Mechanical Engineers*

In conclusion, Prof. Egerton suggested that some control should be exercised over primary fuels and over wheat, which is the key food. In this way the riches of the earth would not be squandered and the material economy of the earth might be run far more smoothly. He also suggested that as much power as possible should be derived from the solar energy which is continuously being showered upon the earth (60,000 times as much as the energy at present being used) rather than from inherited stores. In other words, a greater distinction should be drawn between the use of real irreplaceable capital and replaceable products which the sun provides on the earth.

POPULATION INCREASE IN NEW YORK STATE

FOLLOWING up two previous studies of recent changes in the population of New York State, W. A. Anderson now examines the natural increase in that population (Cornell Univ. Agricultural Experiment Station, *Bull.* **733**, 1940). 'Natural increase' is here measured through an index in which the number of children less than five years of age per 1,000 women aged 20–44 years is divided by a replacement ratio, this ratio being the number of children less than five years of age per 1,000 women, aged 20–44, in the stationary population which would result from the continual operation of the current mortality-rates and in the absence of any migration.

Replacement ratios as of 1930 have been computed by the Scripps Foundation for Research in Population Problems, as follows: New York State 442, Urban 443, Rural 439. Are the populations in the various areas of the State reproducing at these rates? New York State as a whole with an index of natural reproduction of 88, which is 12 points below the necessary, is not reproducing itself, while it is decidedly deficient as compared with the native population of the United States as a whole, which is reproducing at the rate of 112. The urban population of the State has an index of 84 (U.S.A. 86), but the index of the rural population is 120 (U.S.A. 154), that of the farm population being 139 and the non-farm 113. Thus the urban population is not replacing its losses, and inasmuch as 87 per cent of the women of 20–44 reside in urban areas, the urban type of population influences the natural increase of the State most significantly, being about four times as important as the rural population in determining the total natural increase.

Several important social implications result from these facts: If the population remains constant or increases, migration both from without and within the State will be considerable. If mobility within the State increases, this normally being after adolescence, important issues as to the finance and adequacy of education arise, affecting also the standing of churches and other social organizations. The question whether the excess population is being produced by the class most fitted economically, socially, and educationally requires special study, though it has been suggested that it is derived from those least fitted to reproduce at the higher rates.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, January 27

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir David Chadwick: "Some Problems of World Economic Development" (Cantor Lectures, 2).

Tuesday, January 28

ROYAL ANTHROPOLOGICAL INSTITUTE (AND MEMBERS OF THE ROYAL CENTRAL ASIAN SOCIETY) (at 21 Bedford Square, London, W.C.1), at 2.30 p.m.—M. Q. E. Kastrati: "The Impact of Western Influences on Albanian Cultural Tradition".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir William Bragg, F.R.S.: "Diffraction".*

WARBURG INSTITUTE (at the Imperial Institute Buildings, London, S.W.7), at 2.30 p.m.—Miss Rachel Levy: "Relations between East and West among the Earliest Known Civilizations".

Wednesday, January 29

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Lt.-Col. F. C. Temple: "Municipal Manufacture of Humus from Habitation Wastes".

Friday, January 31

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. Alexander Kari: "Effect of some External Factors on the Performance of Single-Screw Ships".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN MATHEMATICS at the North Staffordshire Technical College, Stoke-on-Trent—The Clerk to the Governors, Town Hall, Hanley, Stoke-on-Trent (February 1).

CHIEF ENGINEERING ASSISTANT—The Water Engineer and Manager, The Council House, Coventry (endorsed 'Chief Engineering Assistant') (February 3).

ASSISTANT LECTURER in the MECHANICAL ENGINEERING DEPARTMENT of the Coventry Technical College—The Director of Education, Council House, Coventry (February 7).

GRADUATE ASSISTANT TEACHER FOR MECHANICAL ENGINEERING SUBJECTS—The Principal, Acton Technical College, High Street, Acton, London, W.3 (February 10).

MAINTENANCE ENGINEER FOR THE TRANSPORT AND HARBOURS DEPARTMENT of the Government of British Guiana—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9393).

REPORTS AND OTHER PUBLICATIONS

(*not included in the Monthly Books Supplement*)

Great Britain and Ireland

National Institute of Industrial Psychology. Annual Report and Statement of Accounts for the Year ended 30 September 1940. Pp. 20. (London: National Institute of Industrial Psychology.) [1912

University of Cambridge School of Agriculture Memoirs. Memoirs Nos. 11–12: A Brief Summary of the Papers published by the staffs of the School of Agriculture and its Associated Research Institutes during the period Oct. 1st, 1938–Sept. 30th, 1940. Pp. 41. (Cambridge: School of Agriculture.) 2*s*. [2312

Other Countries

Cornell University: Agricultural Experiment Station. Bulletin 728: An Economic Study of Farming in Tompkins County, New York, 1937. By Philip A. Henderson. Pp. 65. Bulletin 729: Receipts and Expenditures of Rural New York Counties. By O. H. White. Pp. 75. Bulletin 730: Protein and Vitamin Supplements for Growing and Fattening Pigs. By John P. Williams and F. B. Morrison. Pp. 45. Bulletin 731: Experiments with New Electric Devices for Pasteurizing Soils. By A. G. Newhall. Pp. 38. Bulletin 732: Handling and Shipping Lettuce in New York. By Hans Platenius. Pp. 24. Bulletin 733: Natural Increase in the Population of New York State. By W. A. Anderson. Pp. 22. Bulletin 735: An Analysis of Dealers' Sales of Milk and Cream in the New York Market, 1933–38. By Charles J. Blanford. Pp. 24. Bulletin 739: The Incubation Test as an Indication of the Keeping Quality of Butter. By H. B. Naylor and E. S. Guthrie. Pp. 19. Memoir 229; Forest-Site Quality Studies in the Adirondacks, 1: Tree Growth as related to Soil Morphology. By Roy L. Donahue. Pp. 44. Memoir 230: The Morphology of the Apple and other Pome Fruits. By L. H. MacDaniels. Pp. 32. Memoir 231: Analyzing Data for Relationships. By F. A. Harper. Pp. 14. (Ithaca, N.Y.: Cornell University.) [1312

U.S. Department of the Interior: Office of Education. Bulletin 1937, No. 2: Biennial Survey of Education, 1934–1936. Vol. 1. Pp. v+602+6. (Washington, D.C.: Government Printing Office.) [1912

The Story of Vitamin B_1 (Thiamine Hydrochloride U.S.P.) Compiled by Dr. C. R. Addinall. Revised edition. Pp. 72. (Rahway, N.J.: Merck and Company, Inc.) [1912

Smithsonian Miscellaneous Collections. Vol. 99, No. 7: A Systematic Classification for the Birds of the World. By Alexander Wetmore. (Publication 3592.) Pp. ii+12. (Washington, D.C.: Smithsonian Institution.) [1912

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ECONOMIC POLICY AND MAN-POWER

THE need for a comprehensive and coherent policy covering the whole of the economic field has repeatedly been pressed upon the Government, with little apparent effect. One cause of the misgivings often expressed lies in the upward trend of prices, encouraged by the disparity between the purchasing power poured into the market by Government expenditure and the fall in supplies inseparable from war conditions, resulting in some commodities being beyond the reach of families not engaged in any munitions industry, apart from the many whose incomes have fallen off or who have become unemployed. The Purchase Tax itself has given a further impetus to raising the cost of living, and the increase in railway charges has given a sharp reminder of dangers attending the absence of any consistent policy for the control of wages, costs, and prices. Moreover, there has been no indication of the methods by which the Government proposes to prevent the dislocation and anomalies which are bound to attend the increasing deflection of non-essential industries to war purposes if businesses and individuals affected are left to adjust themselves to the new conditions without guidance and assistance. We have no evidence of any plan for collective action by industries to enable them to switch into direct war work the maximum of man-power and equipment with the minimum of friction and economic waste, or of any wide extension of rationing and price-fixing to ensure fair distribution of the reduced quantities of goods available.

The greatest single cause of misgiving is the persistence of unemployment on a relatively large scale. Most economists agree that these figures clearly indicate that the war machine is failing to absorb labour as quickly as the civilian industries are releasing it. Misgivings publicly expressed by such authorities as Prof. Pigou cannot be lightly dismissed, and while leadership admittedly can achieve better results than dictation, such leadership must possess a definite aim and a clear understanding of the means of attaining it.

It is the absence of the prompt and firm use of such powers to remove difficulties before they become really serious which indicates the lack of an adequate central economic plan. Mr. Bevin's general references to an enormous call-up for the Services and for munitions industries between now and next June, coupled with the absence of measures to facilitate even the transfer to munitions work or the armed Forces of the 75,000-100,000 workers which Mr. Greenwood has estimated would be liberated by curtailment of home production between now and May, are indeed somewhat disturbing. The balance between industrial workers and combatants is delicate, and to be determined with the fullest circumspection. The war will be won by mechanisms, not by vast masses of men, and our limited population cannot multiply combatants and the mechanized weapons they require at the same time.

Apart from this difficult question, there is the balance between the distribution of skilled labour not only in the munitions industry so as to ensure the maximum use of all available labour, skilled and unskilled, but also with reference to the demands of the armed Forces, shipbuilding, and the like, for technicians.

Not merely man-power, but the whole of our economic resources, whether production of munitions or foodstuffs, import and export policy, rationing of food or other essential commodities, and restrictions of manufacture and on means of transport or shipping, must fall into the proper place as part of a single economic plan intimately related to the strategy and plan of campaign of the Fighting Services. Above all, this plan must be conceived in an offensive and not purely a defensive spirit, and by minds alert to the creative possibilities of new ideas and new measures.

The recent Cabinet reorganization announced by the Government may be regarded as in some measure a reply to such criticisms. It is, however, difficult at first sight to believe that the re-casting of the machinery thus announced will effect much more co-ordination or eliminate the dangerous amount of free fighting between departments. Mr. Churchill has himself assumed responsibility for ensuring that the work of the Production and Import Executives corresponds to the general policy of the War Cabinet, but we are still without any minister, backed by an adequate selected general staff, to handle the whole field of economic affairs.

The new Import and Production Executive Committees which replace the previous councils, although of much the same departmental composition, will possess executive powers, and their work, as well as that of the three existing committees on civil defence, home policy, and food policy, will be concerted and directed by a committee on which the chairmen of all these bodies sit, under the chairmanship of the Lord President of the Council. This committee will advise the Cabinet generally on the movement of business in the executive committees and on special questions remitted to it. It will also deal with the general issues of economic policy formerly considered by the Economic Policy Committee.

The official announcement expresses the hope that these arrangements will bring the very complicated affairs of government in war-time into a simpler and more closely knit structure, with a reduction in the number of subsidiary committees and the promotion of rapid and decisive action, while preserving the constitutional responsibilities of ministers to the Crown and Parliament. Such a system of committees, however, can scarcely be viewed without misgivings by students of scientific management. *Prima facie*, it appears to disregard the fundamental principles of organization and the span of command, and to place upon the committee system a burden which that useful aid to management should not be expected to shoulder.

Mr. Churchill devoted some part of his speech in the House of Commons on January 22 to a defence and explanation of these arrangements. In spite of a spirited defence of the committee system, the Prime Minister scarcely met the real point of the criticism, and uneasiness as to the persistence of departmentalism was not dispelled, willing as all may be to judge the system by its results. It is, after all, the evidence as to the lack of a general and coherent plan that has stimulated criticism of the machinery of government in the first instance, and the report of Lord Haldane's Committee on the Machinery of Government may yet supply pertinent reading after more than twenty years' neglect.

Although dissatisfaction with the Government's labour and economic policy is freely expressed, it should not be imagined that shortcomings are only to be found on the Government side. There is little enough evidence in Mr. John Price's "Organized Labour in the War", published last autumn in the Penguin series, of a wider vision or sense of unity.

What the Government must recognize is that public opinion fully realizes that our economic and man-power resources, great as they are, are definitely limited, and we can no longer afford to tolerate limitation of output, reluctance to transfer to urgent work because of inconvenient travelling, or opposition to the introduction of trainees. The greatest impatience, indeed, with Government policy arises out of what is felt to be the excessive dependence of ministers upon appeals to the public in matters where they have, at their own request, been given power to take whatever action may be necessary. We can carry our servience to the voluntary principle to a point at which the very cause of freedom is endangered.

Ready as the public may be to accept the use of the compulsory powers with which the Minister of Labour and National Service, for example, has been endowed, it does not follow that the first steps need be taken in his own immediate domain. There must undoubtedly be swifter executive action in dealing with industrial treachery, but the mobility of the national labour force may well be increased indirectly by such means as compulsory billeting for transferred workers, or adequate attention to welfare work. These, with an overhaul of the present priorities system and the careful handling of the extended training programmes and of the effective utilization of the firms engaged in the non-essential industries with their resources in man-power, capital equipment, and business organization, should go far to keep compulsion to a minimum, provided it is clear that the Government will not hesitate to use its powers if necessary.

The industrial registration plan outlined by Mr. Bevin at the beginning of the debate on man-power and production in the House of Commons on January 21, by which it is hoped that all reserves of labour will be mobilized for war work, promises the development of a more scientific policy, although critics in the debate pressed for stronger action. None the less, Mr. Bevin could point to certain measures which had been or were being taken to improve the immediate situation, as in repair and turnover of shipping, and his subsequent statement after his conference with the General Council of the Trades Union Congress and the Council of the British Employers' Confederation should go some way to dispel fears that the Ministry will be lacking in firmness where voluntary measures may fail or prove inadequate.

The paper on "Some Problems of War-time Labour Management", which Dr. K. G. Fenelon gave before the Royal Society of Arts last autumn, illustrates how important a contribution to the conservation and efficient utilization of our man-power resources can be made by wise management. Here, as in the new machinery announced by the Government, it is largely a question of personalities. Men and not machinery will decide whether or not the new War Executive is capable of winning the War.

Co-ordination is, of course, at bottom, the ordinary work of administration. Co-ordination of plans and performance is a condition of the day-to-day working and management of any business or industrial undertaking, and when difficulties arise it is more often that lack of a policy and a programme are the root cause, rather than lack of co-ordination.

What is required now is action, not merely plans, and if Mr. Churchill's reshuffle leads to sovereignty and authority in economic policy and not mere machinery, it may open the way to that gathering momentum in production and ruthless common sense in trade and distribution on which alone victory can be based. Effective action must, none the less, be dictated by a coherent plan taking account of all our resources of man-power and materials, eliminating all sources of waste, and determining the size of our Army, not independently, but in relation to the resources available to meet the needs of the Navy, shipbuilding, and the merchant navy, the requirements of the Air Force, the various branches of Civil Defence, and the demands of food production and transport.

THE WORLD IN UNITY AND STRUGGLE

Dialectics of Nature
By Frederick Engels. Translated and edited by Clemens Dutt. Pp. xvi+383. (London: Lawrence and Wishart, Ltd., 1940.) 15*s*. net.

FREDERICK ENGELS died in 1895, one year before Röntgen's discovery of X-rays and the enormous flowering of physical and chemical knowledge that followed from it. Science to-day is very different from what it was in his time, and the appearance for the first time in English of his main theoretical work, "Dialectics of Nature", may seem a matter only of historical curiosity. We might wonder, indeed, why at this late date it is worth bringing to light at all instead of relegating it to the forgetfulness that has fallen on the theoretical works of even the greatest of the Victorians.

The question can only be answered by picking up the book. "Dialectics of Nature" has a different quality; it does not belong to the normal stream of Victorian thought. Had it appeared at the time it was written, a great majority of scientific workers would not have read it, and those who did would have considered it to be ridiculous philosophic nonsense. That was because Engels did not consider science in any narrow framework; he saw it always as part of a general movement of human and universal history. He had a comprehensiveness of view that appeals to us much more now than it did to his contemporaries. Two trends, one inside science and one in the world of human affairs, have brought us nearer to appreciation of Engels' meaning. The progress of scientific ideas: relativity, the quantum theory, the development of biochemistry and genetics, have added immensely to our understanding of Nature, but they have provided not only knowledge but also deeper problems and difficulties—difficulties that were not visible in the classical scientific world picture which rested on Newtonian mechanics and Darwinian evolution. Engels' main concern is just with those fundamental difficulties; on the relation of matter and movement, on the nature of cause and effect, on the irreversible historic aspects linking the inorganic and the organic worlds.

But science does not proceed in a vacuum. It is not only the world of thought but the world of action that has been transformed and has shown both the enormous growth of human power and the problems and struggles which the social utilization of that power has engendered. Physically as well as intellectually, we are in a far less secure world than our grandparents, and it is in this world of struggle that the ideas of Engels, and of his great companion in arms, Marx, have found their most convincing expression. To the Victorian mind freedom broadened down from precedent to precedent, war became a barbaric anachronism, and ever-increasing prosperity followed inevitably from the proper understanding of eternal economic laws. Marx and Engels were the first to point out that this apparent calm development concealed the most violent conflicts and that these conflicts were not likely to be resolved in any continuous way, but in a series of ever-increasing economic, political, and military crises.

The new way of looking at science comes, therefore, both from within and from without the field of scientific study. The value of the "Dialectics of Nature" is that it is the first sketch of that new view. It is not in fact more than a sketch. Apart from a masterly introduction which sums up the historic and economic view of scientific thought, and three or four chapters devoted to mechanics and physics, we have merely disconnected notes for a book that was never written. But what they lose in order and finish of presentation, they gain in freshness. We have here the immediate impact of Engels' mind on the scientific problems of the day, and we get from it, as Prof. Haldane points out in the preface, an invaluable impression of how to tackle fundamental scientific problems in a new way. To read Engels at all requires abandonment of the fixed prejudices, dear to the traditional English men of science, that science is non-political and non-philosophic. Engels will have none of these limitations and he says why :

> "Natural scientists believe that they free themselves from philosophy by ignoring it or abusing it. They cannot, however, make any headway without thought, and for thought they need thought determinations. But they take these categories unreflectingly from the common consciousness of so-called educated persons, which is dominated by the relics of long obsolete philosophies, or from the little bit of philosophy compulsorily listened to at the university (which is not only fragmentary, but also a medley of views of people belonging to the most varied and usually the worst schools), or from uncritical and unsystematic reading of philosophical writings of all kinds. Hence they are no less in bondage to philosophy, but unfortunately in most cases to the worst philosophy, and those who abuse philosophy most are slaves to precisely the worst vulgarized relics of the worst philosophers." (pp. 183–84.)

The philosophy that Engels introduces into science is derived from that of Hegel, but it bases itself, thanks to Marx's intuition, on the actual world of matter and history, and does not claim an abstract priority of pure thought. This Hegelian origin has been enough to turn many scientific workers, even those most sympathetic to the results of Marxist analyses, such as Prof. Hogben, against their philosophic bases. But actually, as Engels has pointed out, the leading ideas are neither very complex nor paradoxical—they are almost commonplaces ; the value of stating them is that of making them conscious and no longer implicit. For convenience they have been reduced to a small number of phrases, such as the negation of the negation, or the transformation of quantity into quality, but these phrases are merely labels for aspects of material transformations which can be grasped only through their examples, and such examples are given very fully in the "Dialectics of Nature". The fundamental concepts are on one hand the historic unity of the universe in its transition from cosmic chaos to human society on the surface of a minor planet ; and on the other the continual series of struggles and interactions by which are brought about the sequence of transformations that mark off different stages in that development. The sciences of physics, chemistry, biology, and sociology are seen as a hierarchy, not only of complexity but also of time. Each is dependent on the coming into existence of its field of organization. The jumps between one field and the next, as between physics and chemistry, or chemistry and biology, are determined by the conditions operating in the prior field. To resort to an external causal agent is to beg the question ; as Engels wrote, "God = Nescio". The primary condition for the appearance of a new stage is the lack of balance in the older one, a failure in the equilibrium of contrary tendencies. These tendencies are apparent at every stage.

Engels will have nothing to do with special forces, which are merely a means of concealing ignorance. For him everything reduces to matter itself and its forms of motion. At the physical level he considers attraction and repulsion as the characteristic opposite forms of motion. They are not, however, simple motions to and from a point. They correspond rather to potential and kinetic energy of the system. However much they may change places, they never cancel each other out. The modern atom in its half quantum ground state would have been exactly the kind of thing that would have appealed to his imaginative understanding. In another way he was also surprisingly modern; he refers to atoms themselves and molecules not as fixed unalterable units but as nodal points in a series of movements and transformations.

It is, however, in his approach to biology and sociology, where the material is more tractable without the need for the mass attack of the physical laboratory, that Engels' ideas seem more positively fruitful even to-day. His views on the origin of life and its necessary dependency on the pre-formation of complex carbon compounds—"life is the mode of motion of proteins"—is still in advance of that held by many biologists and scientific philosophers of to-day. In organic evolution he was shrewd enough to see that the simple Darwinian picture is too crude a translation of the ethics of free competition into the biological sphere. Here change comes from the struggle, not so much between individuals or species, as between the linked opposites of heredity and adaptation. The inherent tendencies of the organism which embody its history are as relevant as the environmental changes.

With man, as Engels says, we enter history. The characteristic human attributes are to him no longer individual but primarily social. Work, in the sense of activity conditioned by the group, is here the differentiating factor between man and animals:

> "The normal existence of animals is given by the conditions in which they live and to which they adapt themselves—those of man, as soon as he differentiates himself from the animal in the narrower sense, have as yet never been present, and are only to be elaborated by the ensuing historical development. Man is the sole animal capable of working his way out of the merely animal state—his normal state is one appropriate to his consciousness, *one to be created by himself.*" (p. 187.)

If anyone chooses to look at the "Dialectics of Nature" as a final statement of a philosophy of science, and expect from it any immediate addition to positive scientific knowledge, he probably will put it down as obsolete rubbish. But if he does this, he will miss its chief value and the object for which it was written—not to tell people about the world, but to point out how they can look at it and how they can change it. J. D. Bernal.

SONS OF CAMBRIDGE

Alumni Cantabrigiensis

A Biographical List of all known Students, Graduates and Holders of Office at the University of Cambridge, from the Earliest Times to 1900. Compiled by Dr. J. A. Venn. Part 2: From 1752 to 1900. Vol. 1: Abbey—Challis. Pp. xii + 550. (Cambridge: At the University Press, 1940.) 150*s.* net.

The University of Cambridge is deeply indebted to the president of Queens' and his colleagues for the devoted labour with which they have brought so near to completion the great task begun by Dr. Venn and his father thirty years ago. It is a testimony to the value attached to the work by the Syndics of the Press that the volume under review, the first of six dealing with the period 1752–1900, should have been published in the present troublous times.

A comparison of this volume with its predecessors shows naturally that fuller details are known of the individual's career both at the University and in later life than in the more remote periods; something of the romance of the earlier history has perhaps vanished with the years: the old class of student with a career in the learned professions or in public life remains, but new elements have entered, which are making their own contribution to the life of their epoch. The country squire has become the county councillor; new careers like the Indian Civil Service open up; students arrive from the Dominions or India: Jagadis Chandra Bose typified a class of students, unknown in the earlier days, coming from the Far East to study at Cambridge, while Wallis Budge and Thomas Arnold represented the class that went to the Far East to excavate and investigate the great civilizations of the past.

The past tense is used in the preceding sentence because it is not intended in this notice to refer to living persons, though happily many are still alive whose names appear in the volume. These are not so many as they would have been but for the War of 1914–18, which took its heavy toll of Cambridge men, as is abundantly clear from this volume. G. A. Arbuthnot, an ex-M.P., who served for more than a year in a mine-sweeper and was killed in action as a second lieutenant in the Grenadier Guards, is an example of the men we lost serving their country by sea, land and air. Dr. H. Ackroyd, winner of the Victoria Cross, upheld worthily in 1917 the tradition set up by William Bankes in India in 1858. These men gave their lives for their country—so, too, did statesmen like Arthur Balfour and Henry Campbell Bannerman devote their lives to the service of their fellows.

Edward Bulwer Lytton and Augustine Birrell provide a link between statesmen and literature, which is represented by Samuel Butler and Byron ; on the lighter side we have Calverley, Burnand of *Punch* fame, and Bowen of the Harrow songs. Byron's name suggests the first cricket match between Eton and Harrow, when W. D. Brockman played in Byron's eleven. The careers of many a famous 'blue' in the major sports provide interesting reading ; the older sport of travel figures freely, and B. Armytage provides an early link between Cambridge and the Antarctic, while J. Buchanan, the oceanographer, was on the *Challenger* expedition ; J. L. Burchhardt, the noted traveller, left his Oriental manuscripts to Cambridge because he there received his earliest lessons in Arabic, and E. G. Browne came back from Persia to the University the leading authority on Persian literature. W. W. Cassels of the "Cambridge Seven" and C. F. Andrews represent groups of Cambridge men who travelled to the Far East and other lands on a different type of mission.

Pioneers of many sides of life are to be found, such as J. M. Bacon, an early experimenter with balloons ; William Cecil, the inventor of the internal combustion engine; F. A. Abel, who discovered cordite. The results of their work may be viewed with mixed feelings to-day, but there will be general appreciation of W. F. Broadwood, who made the first grand piano. Music brings to mind Sterndale Bennett, professor of music in the University.

Professors on the scientific side include J. C. Adams, Clifford Allbutt, F. M. Balfour, W. Bateson and A. Cayley : their work needs no description in these columns. Others whose names catch the eye are G. B. Airy, astronomer royal, James Alderson, president of the Royal College of Physicians, Babbage of the calculating machine, 'Beetles' Babington, Dr. Bright of Bright's disease, Ernest Brown and R. C. Carrington, whose names are associated with studies of the moon and sun respectively ; also H. K. Anderson, a great University administrator whose name is rightly linked with the new University library. Among librarians the name of Henry Bradshawe stands out. Cambridge families whose members have served their University and their country with distinction in many walks of life must not be forgotten : the names of Balfour, Benson, Brett, Butler, Buxton, Cavendish and Cecil (of Burghley) may be taken as a representative selection.

There remain for mention a few who live in memory for some less obvious reason. Thus we have R. Anlezark, who would eat a leg of mutton at a sitting ; Richard Budd had a nursemaid Emma, afterwards Lady Hamilton (Nelson's Emma), and a housemaid, afterwards a celebrated actress, Mrs. Powell ; G. F. Burrell brought forward persistently in Parliament a bill to prohibit window-cleaning by females ; Dr. Barnardo was the famous friend of waifs and strays, and we must not omit to mention Oscar Browning, "the O.B.", "absurd, profound and above all human"—no bad epitaph for a university don.

F. J. M. STRATTON.

ELEMENTARY ANIMAL BEHAVIOUR

The Orientation of Animals

Kineses, Taxes and Compass Reactions. By Gottfried S. Fraenkel and Donald L. Gunn. (Monographs on Animal Biology.) Pp. viii+352+10 plates. (Oxford : Clarendon Press ; London : Oxford University Press, 1940.) 21*s*. net.

SINCE Jacques Loeb formulated his tropism theory some fifty years ago, a vast amount of work has been done on the orientation of the lower animals in relation to light and other environmental stimuli. This is well summarized and discussed in the present volume by Drs. Fraenkel and Gunn. In its original form the theory of Loeb cannot be upheld ; a classification of these elementary reactions proposed by Kühn in 1919 has to a large extent taken its place in the minds of those who approach animal behaviour from the physiological point of view. It is to Fraenkel that we owe the first full exposition of Kühn's views published in Great Britain (1931), and to Gunn the revised and modified classification here presented in the first part of the book. He distinguishes between kineses or undirected reactions, taxes or directed reactions, and transverse orientations (to light and gravity). Kineses are subdivided into ortho-kineses and klino-kineses, and taxes into klino-taxes, tropo-taxes, and telo-taxes. In the second part of the book the available data about these reactions are considered under the headings of the different kinds of external factors "which control them"—temperature reactions, gravity reactions, reactions to chemical stimuli and so on. Many of these chapters are exceedingly valuable to the serious student by reason of the wealth of references and the careful exposition of the most modern work on the subject. The book is very well indexed and there is an extensive bibliography.

There is at present much diversity of opinion as to the proper method of approaching the study of animal behaviour. Some hold that a psychological interpretation is necessary, others that a purely physiological treatment will suffice. The authors appear to reject the former alternative as being "anthropomorphic", and to cling to the old Loebian conception of the animal as a mechanism actuated by stimuli. Thus they describe their book as "principally concerned with the way in which the various external factors—light, smells, currents, heat, and so on—operate the living mechanisms and lead to orientation" (p. 3). Yet they admit that the behaviour of a rat in learning a maze "cannot be described otherwise than in terms of memory or purpose, whether they are overtly so or not" (p. 316). Their attitude seems to be that mechanistic interpretations must be pushed as far as they will go, but supplemented by psychological if the facts absolutely demand it. I do not think this is a very satisfactory position, and I doubt very much the value of treating even elementary behaviour in terms of kineses and taxes; it seems to me too *simpliciste* and abiological. To my mind a psychological and biological interpretation is required all through, and I agree with Bierens de Haan (1940) in thinking that these orientation responses are best regarded as instinctive behaviour of a simple kind, biologically significant in relation to the normal environment and the normal needs of the animal, though not consciously purposive. Some approach to this point of view is indicated on p. 190, where it is recognized that light is often a 'token' stimulus, representing something of biological significance. The authors are well aware of the methodological difficulties in the study of animal behaviour and discuss them at some length, though not very conclusively.

E. S. RUSSELL.

TECHNICAL DYNAMICS

Technische Dynamik

Von Prof. C. B. Biezeno und Prof. R. Grammel. Pp. xii+1056. (Berlin: Julius Springer, 1939.) 78 gold marks.

IN introducing the student to technical mechanics either by lectures or text-book it is usual to lay stress on those simplified problems which illustrate the principles. The more difficult problems in the form in which they face the mechanical engineer, even if touched upon, do not receive the detailed consideration which their importance not only warrants but demands. The present book is designed to form a continuation of the introductory course and may be described as a treatise on technical applications of elastomechanics for advanced students.

According to Kirchhoffe's definition, mechanics consists of kinematics, or the study of motion, and of dynamics, or the study of forces. In this sense dynamics can be divided into statics, the geometry of forces and the theory of equilibrium, and into kinetics, the theory of forces not in equilibrium and the relations between force and motion. For example, an oscillation problem is a dynamical one consisting of a statical part, namely, the investigation of certain elastic properties, and a kinetic part, the calculation of the frequencies. The looser current usage takes dynamics as a synonym of kinetics, and while still describing the oscillation problem as dynamical, neglects the statical part, which is often the more difficult if not the more interesting.

The authors use dynamics in the sense defined by Kirchhoff, and have accordingly investigated both the statical and kinetic parts of a variety of problems concerning rods, shafts, rings, springs, plates, shells and their combinations, keeping in view that any such problem is only worth solving when it has a practical application, and can only be described as solved when a detailed solution in numbers is forthcoming without recourse to too prohibitive numerical calculations. It must not be inferred that the book is a wearisome list of numerical results. On the contrary, great emphasis has been laid on methods of solution; in fact a chapter of 100 pages is devoted entirely to such methods. In the applications, solutions are not merely outlined but are given in full as the engineer would have to work them, and with the choice of method which the authors consider to be the best.

The text is divided into four sections: fundamental theory, 225 pages; single parts of mechanisms, 400 pages; the steam turbine, 220 pages; internal combustion engines, 210 pages.

The first section contains an exposition of the mathematical theory of elasticity as applied to isotropic bodies which obey Hooke's law; indeed phenomena outside the elastic limit are not considered in the sequel. This account of the theory is well and carefully written. It is refreshing to see the authors emphasize the strict limitations of the theorem of unique solution of elastic problems, in that in actuality finite (but small) strains and finite (but not small) stresses represent only approximations to the conditions in which the classical equations are valid. A simple illustration is Euler's strut at the first critical load. Another welcome feature is the inclusion of the proof of de Saint Venant's principle based on that given by Zanaboni (*Atti Lincei*, 25 ; 1937). With regard to the general theorems of elasticity it is to be regretted that the authors have not given the vector formulation which makes the physical implications much easier to grasp.

The remaining three sections consist of applications of elasto-mechanical theory with special emphasis on the needs of machine construction. Special prominence is given throughout to critical loads and values.

The authors remark in the preface that the chapters have been arranged so far as possible so that each can be read independently. This has been achieved within limitations, but the text requires close attention on the part of the reader, who is assumed to be proficient in elementary mechanics and to have a fairly extensive knowledge of mathematics.

The book is a mine of detailed information such as could probably not be found in collected form elsewhere (for example there are 89 pages on the loaded rod) and it should therefore prove to be of great value, and, one regrets to add, of great cost. L. M. MILNE-THOMSON.

MODERN DRUG THERAPY

Modern Drugs in General Practice
By Dr. Ethel Browning. Pp. vii + 236. (London : Edward Arnold and Co., 1940.) 10*s*. 6*d*. net.

IT has been said that prontosil with its colourless prototype sulphanilamide are destined to be regarded as one of the greatest boons to mankind conferred by the present age. Having regard to that opinion, which few will dispute, the author is not without justification in devoting one-sixth part of a book on modern drugs to the sulphonamides ; indeed, had it been thought necessary to extend this not-too-long chapter, a few of the eleven pages on gold salts might have been spared, for, admittedly, gold therapy is strictly limited in its applications.

Experience in the treatment of the war-wounds of the civil population during the past few months, and even the past few weeks, has added to our knowledge of the richness and even the shortcomings of the sulphonamides, which, of course, can only be recorded in current literature, but nevertheless can be the more readily appreciated against a background such as Dr. Browning has provided. Another topical chapter is the one concerning external applications and local anæsthetics ; again, in this connexion, much has been learnt, in recent months, in the grim school of experience ; much is still being learnt.

When this book was commenced, and even when the labour was over, it was generally believed that tannic acid was the dressing *par excellence* for burns, but in the past few weeks it has been shown that there are pitfalls in its way, and that in no circumstances should tannic acid preparations be used on burns of the hands or face. It should be noted that Dr. Browning puts it on record that gentian violet has been found in many cases more efficacious than tannic acid as a remedy for burns, especially when combined with other antiseptic dyes, and mentions that a successful method for severe and extensive burns is to combine gentian violet, brilliant green and acriflavine as a 'three-dye' mixture which forms a stable solution, relieves pain, forms an eschar, thinner but more flexible than that formed by tannic acid, and obviates the preliminary cleaning-up which is so painful and likely to increase shock in cases of extensive burning. Incidentally, a jelly containing gentian violet and merthiolate (sodium ethylmercurithiosalicylate) was recently substituted for tannic-acid jelly as a first-aid application in the Navy and Royal Air Force.

Nearly half the chapter on cardiac drugs is devoted to the digitalis group ; digitalis, although it has been known to medicine for centuries, is not out of place in a treatise on modern drugs if only for the reason that its glucosidal derivatives, as, for example, digitoxin, digoxin, digalen, and so on, which have to some extent replaced in clinical practice the older galenical preparations, are of comparatively recent introduction. Other chapters deal helpfully with drugs acting on the autonomic nervous system, diuretic and urinary antiseptics, and sedatives and hypnotics. The "easy availability" of the barbiturates, referred to in the pages dealing with sedatives and hypnotics, is no longer a ground for objection to the valuable drugs in this group, since the Poison Rules prohibit their use except under medical supervision.

MENTAL HEALTH IN WAR-TIME*

BY SIR WALTER LANGDON-BROWN

IF there is one thing which is certain about the outbreak of wars, it is that the ostensible reason is not the real one. Emotional causes are always transformed into ones alleged to be rational. We know that when a quarrel blazes up between two individuals over a trivial matter, there are deep-seated and hidden causes of antagonism at work. In the same way, no one to-day believes the shooting of an archduke by an insignificant conspirator was the real cause of a war which devastated a large part of the globe for more than four years and cost millions of lives. The cause lay deeper.

Sir Flinders Petrie, in his delightful little book, "The Revolutions of Civilization", maintains that each civilization goes through a cycle, waxing, flourishing and waning in turn. He plotted this out in curves, based on certain recurring features in each civilization. Now the interesting point is that, whether one agrees or disagrees with his views, in this book published in 1911, his curve for the present civilization cut the base line in about 1914. In my Maudsley lecture for 1936 I directed attention to Sir Arthur Keith's dictum that there are two opposing tendencies in life—one the general demand for the enlargement of the social unit—the other the species-making impulse which attempts to segregate a particular type. I ventured to point out that in human life the first makes for internationalism, the second for nationalism. The fierce fanatical outbreak of nationalism which this century has witnessed becomes comprehensible as a frightened response of the species-making segregating impulse against the imperious, resistless demand of the ever-widening evolutionary process towards internationalism.

Now amid all the differences between schools of psychology, there is general agreement on this point—if a normal healthy impulse is forcibly repressed it is apt to come to the surface again in an abnormal pathological form. If this evolutionary demand comes into opposition with a nation that is at once convinced that its culture is the only one really worth having, and is filled with the spirit of aggression, the result is not difficult to predict; and though that spirit of aggression was temporarily checked, the consequences to civilization proved more serious than was realized at the time of the Armistice in 1918.

We now see that the years 1918–1939 were but a troubled armistice between two wars, during which the building up of vertical walls between nations was countered by horizontal lines of cleavage, which threatened to divide Europe into Fascists and Communists. This to my mind represented the pathological form of internationalism resulting from repression of its normal expression. The well-intentioned League of Nations was quite inadequate to deal with the resulting situation. Then extremes met in the Russo-German pact which indicated a new orientation, the division now being between those nations which considered that the individual existed for the State, even though "the State" meant a few autocrats, and those which thought the State existed for the individual. Meanwhile, amid these pathological manifestations an internationalism was arising, and one which seems to us normal and healthy, in the free association of nations within our own dominions. Since the military, political and moral collapse of France, the United States has been thrown into closer relations with that association, and there are clear indications that this process is likely to extend.

This, then, seems to me the background against which the present War is being waged; a moral and spiritual disease in Europe as the result of attempts to stem the tide of the evolutionary process. Also we can admit that on our side the idea of liberty has been too negative, and that we have not formulated a positive conception that is sufficiently adequate for the situation.

Let us now turn to the effect of all this on the mental health both of the community and the individual. One is rather tired of the platitude that the child is father to the man, and yet to-day I am forcibly reminded of it. Watch a child playing with his bricks and carefully constructing an elaborate edifice. Then suddenly his mood changes and with a scream of delight he knocks the whole thing over with a sweep of his arm. It makes us realize that from the first both constructive and destructive impulses are present in the human mind and that there appear to be epochs when the destructive one simply runs amok. Such an epoch we are now passing through. Of course this impulse is rationalized, and it is claimed that the old state of affairs was so bad that it had to be destroyed before anything better could take its place. I do not believe that applies to a complex civilization; but, then, I believe in evolution and not in revolution.

The common man wants to be left in peace with his wife and family and carry on his ordinary avocations. Unless those are threatened, only the adventurous want to fight. Therefore it has always been a common device of absolute rulers to distract attention from internal difficulties by telling their peoples that some other nation is trying to deprive them of their heritage. As we are gregarious animals, we close our ranks at a hint of danger. The thrill of alarm brings also a new sense of unity; men cannot bear to feel isolated, and barriers break down. A new spirit of tolerance and good will springs up with a readiness to sacrifice to a common end. All this is to the good, but these earlier effects are not always lasting.

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* From a Chadwick Public Lecture delivered at the Royal Society of Tropical Medicine and Hygiene on February 4.

Nations at war look instinctively for a leader. Whatever else he does or lacks he must capture the imagination. He must be regarded as a superman, but with some appealing traits. It does not matter if the leader is credited with characteristics he does not possess; the virtues of Kitchener and Hindenburg were great, but not identical with the popular estimate of them.

Prof. Jung must have been prophetically inspired when he said in a lecture in Vienna as long ago as 1932 (and I am only condensing his remarks without adding to them):—

> "Everything could be left as it was if a new way of life were not absolutely demanding to be discovered and was not visiting humanity with all the plagues of Egypt until it is found. Instead of being exposed to wild beasts, tumbling rocks and inundating waters, man is exposed to-day to the elemental forces of his own psyche, and so he seeks with more intensity than ever for personal leadership. This is an indestructible human need, but once tradition has been sufficiently lopped off by the revolutionary, unhistorical and therefore uneducated inclinations of the new generation, leadership is the more fanatically defended the more unsuitable it is."

Leadership, then, is a necessity, and as in so many aspects of war mentality, the emotional predominates over the intellectual assessment of the value of the leader. From the South African War onwards I have been struck with the 'writing-up' of leading generals, obviously to inspire confidence in them, a confidence which in several instances was proved by subsequent events to have been misplaced. A leader who can both arouse emotion and appeal to reason is indeed an asset—and we believe that we have such a one.

In ancient times the supremacy of the emotional over the rational attitude expressed itself in consultation of augurs and omens and of ritual observances before going to war, as an attempt to allay inner anxiety and guilt. When war comes, each side firmly and fiercely denies its responsibility, however obvious the facts may be. Indeed, the guilty party is usually the more vociferous in its denials because deep down it feels the truth of the indictment. Then in times of national anxiety there is a regression to certain primitive mental traits. This was well illustrated in Germany by the ritual of driving nails into the gigantic wooden image of Hindenburg, a totem figure of the tribe. A commoner tendency is the making of myths—an escape from reality into fantasy. In the early days of the War of 1914–18, the myths of the angels at Mons, and of the Russian troops passing through England, were widely believed. War had seemed incredible, and these consequences seemed no more incredible. This time war has been threatening for so long that there was not the suitable atmosphere for the propagation of such naïve myths, and people have more sense of reality now. Local rumours exaggerating the damage done by air raids have, however, been abundant. Curiously enough, spreading bad news appeals to vanity. Where facts are few, rumours are rife. The best cure for rumour is information. From the frequency with which Virgil refers to rumour, we may surmise that the Romans were plagued by it. Rumour, he said, "has a hundred tongues, a hundred mouths, a voice of iron". Again, "Rumour, than which no evil thing of any kind is more swift, increases with travel and gains strength by its progress." Since then a swifter method of spreading false reports has been bestowed on the world by science in wireless. Thereby the power of the lie has been enormously enhanced. Truth seems to be a very plodding tortoise compared with the racing hare of lies.

Now all those traits—the demand for leadership good or bad, the reliance on myth and rumour—arise from the same cause; as gregarious animals we are always suggestible, and never more so than when we are in danger. As Mr. Wilfred Trotter pointed out, the physical dependence of the infant develops later into suggestibility which is psychic dependence, a necessary pre-requisite of group life and activity. The dependence of infantile life thus develops into the inter-dependence of social and communal life. It was the greatest weakness of Thomas Hobbes' philosophy that he tried to deal with man as a separate unit—*in vacuo*, as it were. This is impossible. The right course is to canalize this inevitable suggestibility, heightened as it is in war-time, into co-operation.

The greatest enemy to be overcome is fear. For years insidious propaganda has skilfully instilled fear like a creeping poison until, as we have seen, nation after nation has just waited its turn like a rabbit paralysed by terror at the stealthy approach of the stoat that will presently seize it by the throat. It may well be that this could never have happened if at the very moment when nationalism seemed at its very height, there had not been a subconscious feeling that nationalism itself would prove to have been decaying at the roots. It is worth while, then, to inquire into the genesis of fear. It is the survival, and sometimes the perversion, of a defensive mechanism of great antiquity and real value; alertness in the presence of danger, by which the whole organism is keyed up, ready for action. It is activated through the sympathetic nervous system, which prepares the body for fight or flight. But if action be prevented, the same mechanism produces fright. Then, as Crile puts it, we become like motor-cars with the clutch thrown out; petrol is consumed, and the whole car may tremble from the violent action of the engine, but the car does not move. This is the scientific explanation of the fact that the best corrective of fear is action.

Psychologists tell us that an unconscious persistence of an infantile sense of guilt is a large element in exciting fear. That may be so, but it does not help when the sirens sound; there is no time then to be analysed and have our infantile fantasies exorcised! A distressing form of fear is that which comes from being afraid of being frightened. This is clearly due to a conflict between two powerful instincts—the instinct of self-preservation and the herd instinct, which strongly condemns what seems like cowardice. Action as a member of a community, especially if under suitable leadership, is the best antidote.

Dr. W. R. Bion, who has recently written helpfully on community feeling in war-time, considers that the civilian is at a disadvantage compared with the soldier, in that he has not had the disciplinary training. The soldier can form a tolerably accurate picture drawn from experience of similar conditions; the novice tends to be flooded with emotions which he cannot check by appeal to facts. There is even a chance that the aggressive component of these emotions will be directed towards his own side rather than towards the enemy.

The soldier is a member of a close unit expressly designed for facing tasks which involve the possibility of death, whereas the civilian has no really powerful check to his natural desire for self-preservation and may be isolated in a way which causes a loss of social sense. The strain will be diminished for those civilians who are serving in some organization which has definite clear-cut aims, with powerful emotional appeals and a discipline. It is necessary to find some modification of the disciplinary framework that exists in a fighting service and to adapt its organization to the needs of the civil population.

Dr. Bion quotes from Tacitus a description of the conduct of the German tribes warring against the Roman troops of the Emperor Trajan—of the way that they inflamed their minds with barbarous poetry (in a hymn of hate), the furious uproar, their uncouth and harsh vociferation, interrupted at intervals by the application of their bucklers to their mouths, so that the noises burst out with redoubled force. Students of infant behaviour have noted that the earliest fear a child experiences is that excited by noise, and the Germans, true to their own tradition, have actually added devices to their shells, whereby the screaming noise of them may be still further increased, so as to arouse a primitive type of fear. This could reasonably be countered by the use of ear plugs, which would be both physically and psychologically protective.

We can understand why pessimism and fear are chiefly prevalent among those who are doing nothing, or at any rate not contributing to our war effort.

The best antidote to fear is action; and we need an antidote, for we cannot expect to be entirely free from fear. The Emperor Charles V, seeing on a Spanish nobleman's tomb the epitaph, "He never knew fear", remarked, "Then he never tried to snuff a candle with his fingers!" Sir Philip Sidney expressed the same idea in more serious style when he wrote, "Fear is more pain than is the pain it fears".

The general experience, however, so far, bears out the report of a conference of medical men convened by the Minister of Pensions before the active stage of war began. They stated that a very exaggerated estimate had been formed of the liability of war to produce nervous breakdown. This has been amply substantiated since the intensified air raids on Great Britain have been in progress, and that in spite of all the suffering and loss that have resulted. A writer in the *British Medical Journal* explains this in an interesting way thus: "With the constant threat to the existence of the entire community constituted by repeated and indiscriminate bombing, a superb scapegoat is at hand. . . . The facility with which one can now project one's fears and anxieties is likely to be the most important one" in preventing such breakdowns. "The herding together of individuals in shelters in the face of common danger and the levelling-out process in society which is consequent upon universal hardship have no doubt been essentially responsible. Further, the opportunity for dramatization afforded by narrow escapes, etc., is a decided factor."

During the Spanish Civil War it was found that in Barcelona, a particularly heavily bombed city, nervous breakdowns were neither numerous nor severe. An interesting comment on this was made by a German refugee professor, now in Great Britain, to the effect that in a civil war everyone fanatically takes one side or the other, while in a war between nations the individual is less personally involved. As this professor served in the German army in the War of 1914–18, this view is specially interesting, because if individual Germans felt that way then, it is almost certain they feel more so now. It is also reassuring to have confirmation of our belief that confidence in the justice of a cause is a splendid preventive of nervous breakdowns. That confidence we possess.

The danger underlying herd feeling is panic, for we are suggestible in a wrong as well as a right direction. Therefore anyone who goes about suggesting that an epidemic of nervous breakdown is likely, for which there is really no warrant, is doing what he can to produce panic. In the War of 1914–18 the populace was singularly free from panic, as it is now under much more trying conditions, and it was rather surprising that before Munich there were symptoms of this dangerous response to danger. The intervening eleven months seemed to steady the nerves of the people of Great Britain and to transpose the liability to panic on to some of our administrators.

By what other methods besides co-operative action can we help to preserve mental health in war-time ? Physical fitness undoubtedly helps. I remember in the War of 1914–18 a man telling me that it was his duty every night to take supplies up to the front line, which he did without fear, until one night when he had a severe cold ; on that night he experienced acute fear.

To obtain sufficient sleep is also essential to maintaining physical fitness. Rather than disturbing rest by a flight to a shelter, in many cases it is sufficient to arrange bedrooms on the ground floor or in the basement. I am reminded of the old controversy whether to shelter under a tree in a thunderstorm or not. You have to put the remote prospect of that tree being struck by lightning against the much greater chance of a severe chill from getting soaked. Poincaré, the mathematician, and brother of the politician, said during the air raids on Paris during the War of 1914–18 : "I sleep securely under the shelter of the laws of probability." However, the probabilities are less favourable now than in that war.

It is clear from the report of Lord Horder's Committee that the conditions obtaining in many shelters are not conducive to physical fitness, to put it very mildly. If we are to be condemned to revert to the cave man's existence, there is no reason why we should also revert to his primitive ideas of sanitation.

Cheerful surroundings help to banish fear. The Germans proclaimed a war of nerves months before hostilities began, and they have gained considerable success by the menace of air raids which has necessitated the 'black-out' with its depressing effect. If there must be darkness without, there can be and should be light within. You absorb more from rooms furnished and decorated to your taste than perhaps you imagine. You think you have ceased to notice a charming picture on your walls until it is taken away. Then you miss it at once, which shows it was always exerting its effect, although you were apparently unaware of it. That is where life in shelters is apt to have an evil effect in this war of nerves.

Books are a great solace these dark nights. I am enjoying renewing my acquaintance with that fine English literature of the last century which this restless age has been neglecting to its own disadvantage.

Do not omit to meet your friends, and if rationing compels simpler hospitality, remember that in the eighties of last century this was generally the custom, and we were certainly not less happy. Then there is the radio. Needlework reached artistic heights during the Napoleonic Wars ; the creation of beautiful things always has a cheering influence. If you are feeling too geared up, lie down, close your eyes, breathe deeply and relax all your muscles. Do it for twenty minutes at a time. This is a great help, for you can waste a lot of nervous energy by just uselessly tightening up your muscles if you are feeling frightened. But the main thing to do is to change useless muscular action into some useful activity.

We have reserves of tenacity and endurance, inherited and maintained through generations of stable and equable ancestors. Boswell once said of some behaviour of Dr. Johnson to his College tutor, "That, sir, was great fortitude of mind", to which Johnson replied, "No, sir, stark insensibility." I do not think our national fortitude is based on insensibility. We may well scoff at pretentious and unjustified claims made elsewhere to racial purity. We are the product of the fusion of many tribes, from which something new emerged, differing from its original constituents as much as an amalgam of metals differs from its separate ingredients ; a people liberty-loving, tolerant, humorous but reticent, steadfast but quite unwilling to look unpleasant facts in the face until compelled to do so. Thus, though a peace-loving nation, when we do get roused we become the more fierce precisely because we resent the necessity for it. Just a century ago de Tocqueville said of democratic peoples, "The same passions which made them attach so much importance to the maintenance of peace will be turned to arms. . . . Hence it is that the self-same democratic nations which are so reluctant to engage in hostilities sometimes perform prodigious achievements when they have taken the field."

In the interests of our mental health we must be determined to carry on in the same liberty-loving spirit into the peace, which will have its own special difficulties. Prof. R. B. Mowat, in an interesting article, has pointed out that, from the French Revolution to the Battle of Waterloo, the whole of Europe was in the melting-pot before the impetus of that revolution was exhausted. In the same way it has been again in the melting-pot since 1914, and again we may expect the impetus of this revolution to die down. Then, as before, will come the period of reconstruction. What kind of world will arise depends much on our attitude now—it will decide whether the melting-pot is to be a witch's cauldron or a refiner's fire.

If we are to escape future disasters we must learn more about ourselves and our own nature. The ancient Greeks, and in our time Thomas Hardy, regarded man as the sport of inevitable fate ; the modern psychologist shows us that fate is the outcome of individual and national temperament. The future is ours to redeem, and this can only be achieved by self-knowledge and mutual sympathy. One of the direst aftermaths of war is an inevitable hardening of the boundaries between nations and the withdrawal of feelings towards international sympathies. That is why the League of Nations failed, and why for the present federal union can only remain a dream. Nevertheless, it is an excellent thing to talk about federal union ; it took years of talk to accustom men's minds to something so obviously right as the abolition of slavery.

Yet a more international spirit will have to arise if civilization is to be saved. Isolation in thought and ideals is absurd at the very time when wireless has joined up the whole world and it has become increasingly clear that even material prosperity depends on commerce being international. Peace must mean more than simply the cessation of war ; it must be based on a new spirit of co-operation and we must hope for its emergence from the refiner's fire. H. G. Wells has said that the only chance of ever becoming more reasonable is by realizing how unreasonable we are ; to which one might add—and by trying to understand why we are so unreasonable. Recent events have proved that, under the superficial crust of civilization, the age-long forces of savagery and brute instinct are still alive. To recognize their existence is the first step to canalizing their energy in right directions. "In man's very flesh and bones is the impulse towards closer and closer union in larger and larger fellowship. To-day he is fighting his way towards that goal." The path is difficult and will be fraught with many disappointments as in the past. It was recently remarked that the problem of the future is to combine individual freedom with collective responsibility. On whether we can achieve this or not depends the future of civilization. The world stands at the parting of the ways.

THE OIL/WATER INTERFACE

By Dr. J. H. Schulman,
Department of Colloid Science, Cambridge

A JOINT meeting of the Faraday Society and the Physical Society was held in London on January 9 to discuss the oil/water interface. In spite of adverse conditions which prevail at the moment for such meetings, and the impossibility of the meeting taking on its usual international atmosphere, the room was quickly filled beyond capacity. There were also some of our Dutch, Belgian and Greek colleagues present to keep alive the spirit of international collaboration in science, fostered by the Faraday Society discussions. The discussion, which was opened by the president, Prof. E. K. Rideal, was at times very animated. The president stressed the implications this subject has on a very large number of scientific and industrial fields, and the papers read were divided into biological, physical, chemical (emulsions), and theoretical sections.

The chief aspects dealt with in the papers read were the influence of the chemistry and structure of the interface on the adsorption and diffusion of ions and molecules on to and through the interface and on the kinetics of reactions taking place at the interface; likewise also, the influence the chemistry and structure of the ion or molecule has on the above factors.

Dr. A. E. Alexander (Cambridge) started the discussion by giving a review of the monolayer technique applied to both the air/water and oil/water interfaces, and stressed the use which a combination of the two methods has on elucidating and predicting phenomena occurring at the interfaces. Attention was directed to the fact that surface potential measurements at an oil/water interface can be made if the ionizing air electrode is in the air above, and not if the ionizing electrode is in the oil layer just above the interface. The oil layer has to be of the order of only 1 mm. or 2 mm. in thickness.

The discussion then centred on the fact that at the oil/water or air/water interface the equation of state for substances examined by Alexander and Teorell gave 3/2 KT instead of KT as previously found by Langmuir.

It was pointed out by A. B. D. Cassie and R. C. Palmer (Leeds) in their paper that deriving a surface equation of state for strong electrolyte detergents by a combination of the Poisson, Boltzmann and Gibbs equation gave a factor of 3/2 KT for ionized films as compared with KT for unionized films. They actually used Alexander and Teorell's results to confirm their theoretical deductions. It would appear that the presence of the ionized polar group at the end of the hydrocarbon chain, as compared with an unionized polar group or dipole, is responsible for this 1·5 factor in the equation of state for monolayers at interfaces. A confirmation of this suggestion was considered important.

Dr. G. S. Hartley gave the first demonstration of how simple alterations in the structure of the adsorbing molecule can radically affect interfacial conditions. It is known that the lowering of interfacial tension at the oil/water interface is due to the ions of the paraffin chain salts, and the sudden break in the interfacial tension concentration curve coincides with the formation of micelles.

Hartley reasons, therefore, that by changing the structure of straight single-chain paraffin salt to that of a double-chain salt, two changes in the interfacial tension phenomena curves should take place. First, on changing the configuration of the non-polar portion of the molecule, one alters the adhesion balance of the molecule with the water molecules. Thus, with two chains there would be more accessibility for the water molecule to the hydrocarbon molecule than with one chain; hence the double-chain molecules would have less interfacial activity at identical concentrations. However, since steric factors with the two chains would alter the micelle packing, greater concentrations of the double-chain ions would be required before micelle formation can take place. Thus one should obtain with double-chain molecules a greater lowering of the interfacial tension than with a single-chain molecule containing an equal number of carbon atoms.

This theory is very prettily justified experimentally. Single-chain ions of sixteen carbon atoms, or double-chain ions with one long and one short chain, lower the interfacial tension at low concentrations to a greater extent than double-chain ions of eight carbons each. But at higher concentrations the double-chain ions lower the interfacial tension to much smaller values than the single-chain ions. This fact is well demonstrated by the spontaneous emulsifying properties of sodium dioctyl sulphate (Tergitol) as the agent in an oil-in-water system as compared with sodium cetyl sulphate, showing that there must be a very low interfacial tension of the solution of the double-chain molecules.

A. C. Frazer (London), J. F. Danielli and J. H. Schulman (Cambridge) showed how physical chemical studies of interfacial phenomena can be applied to biological problems.

Frazer has established by a series of direct analogies with artificial systems that the particles which exhibit strong Brownian movement in blood plasma are fat emulsions, stabilized by a protein film around each particle. The particles consequently behave as a protected colloid and have all the physical chemical properties of the adsorbed protein and not of the fat of which they are essentially composed. Furthermore, the protein adsorption is specific, since the particles take on the characteristics of the globulin fraction of the serum. Strong support is given from the monolayer and electrophoretic techniques in establishing the fact that fats adsorb preferentially the globulin fraction of the serum and not the albumen fraction.

Discussion immediately centred around this important result. It was considered unlikely that the fats could participate in this specificity, and it was suggested that it was due to some difference in the chemical constitution of the proteins affecting their hydrophobic – hydrophilic balance. The globulins were supposed to have more CH_2 groups in their side chains than the albumens; but on the other hand the serum globulins are known to associate with lipoid substances specifically in the serum, which may account for their ability to adsorb on to fats, etc.

It has been shown by Frazer that this preferential adsorption of the important serum globulin which is associated with the immunity properties of serum, is given also by toxins (bacterial and snake venom) and hormones such as insulin. The biological activity of these substances is completely inhibited when they are in the adsorbed state. Apparently the phenomenon is reversible since, upon the emulsions being broken, the biological action of these substances returns. This is a very good example of how orientation of a molecule or certain components of the molecule at an interface can radically alter its chemical activity (as exemplified by its biological action). The significance of these results was fully appreciated by the meeting.

J. H. Schulman demonstrated how alterations in the structure and orientation of molecules composing the interface can also radically affect the course of a reaction taking place at the oil/water interface. From direct analogies as to the mutual orientation of the hydrocarbon chains attached to the acid and alcohol radical of an aliphatic ester at an air/water interface, the adsorption of OH′ ions to the interface and the specificity of the digestion of aliphatic esters by ferments can be explained. Thus when the hydrocarbon chains are orientated parallel to one another (*cis* form) leaving unrestricted approach to the polar group from the water phase, adsorption of OH ions can take place together with digestion of the esters by lipoclastic ferments. If the chains are orientated opposite one another (*trans* position) adsorption of OH′ ions is greatly restricted and digestion is completely inhibited. It requires only a 5-carbon atom hydrocarbon chain on the acid radical to bring about complete indigestion of the ester; but 5-carbon atoms on an alcohol radical chain permit the molecule to orientate in the *cis* position and be easily digested. Thus, ethyl valerate is indigestible, but amyl propionate is readily digested by the lipoclastic ferment in pancreatin. The activity of the ferment itself is enhanced by the presence of most paraffin chain salts both positive and negative, except that of the long-chain sulphates, which cause complete inhibition of the ferment action in minute concentrations.

The adsorption of OH′ ions at oil/water interfaces was discussed in some detail following the presentation of results obtained by the school of Prof. W. C. McC. Lewis at Liverpool on the electrophoresis of emulsions or suspensions of oil in water (W. Dickinson and G. Growney).

It was shown that the adsorption varies markedly with a number of factors. In the first place, it varies with the physical nature of the surface, that is, liquid or solid. Discussion took place on the interesting fact that the increase of adsorption of OH ions in alkaline solution on the change from a solid to a liquid is gradual. The melting point gives no marked change. This was explained by the fact that X-ray diagrams of paraffins show no marked change over the melting point. Thus the change in area of the surface molecules in the neighbourhood of the melting point can be considered as changing gradually and not in a sharply defined manner as characterized by the melting point. This also gives an explanation for the apparent anomaly of the adsorption of OH ions on mixtures of ethyl laurate and stearic acid.

Stearic acid alone is a solid, but mixed in small concentrations with ethyl laurate it will give a liquid film of adsorbed stearic acid at the ethyl laurate/water interface. A liquid film of stearic acid will adsorb more OH ions than either a solid film of stearic acid or a liquid film of ethyl laurate.

The adsorption also varies with the stereochemical structure of the oil phase and hydrogen ion concentration. Thus aliphatic long-chain esters fall into three groups: those that are solids which adsorb OH ions poorly; those in which the esters are orientated in the *cis* form, which absorb OH ions gradually with increasing pH, and those in which the esters are presumably orientated in the *trans* form, or in a form which only permits adsorption to take place at pH 9.

Discussion took place as to the reason why the electrophoretic mobility of ester (or other hydrocarbon compounds) suspensions changes with increasing pH until pH 9 is reached, and then remains nearly constant. There is no change in the curve over the region where hydrolysis is known to commence. There was no adequate explanation forthcoming for these interesting facts, which may have some bearing on the mechanism of hydrolysis in general.

J. F. Danielli (Cambridge) gave a theoretical interpretation of interfacial phenomena as related to a living cell. The cell membrane consists (to a first approximation) of a thin oil layer with a protein film adsorbed on its two surfaces. A molecule penetrating through the membrane must penetrate (*a*) the external interface, (*b*) diffuse through the thin oil layer, (*c*) penetrate the internal (cytoplasm-oil) interface. Attempts were made to plan the kinetics of diffusion through this system on a quantitative basis: this problem cannot yet be dealt with accurately owing to lack of a theory of diffusion which is cognizant of the influence of structure on diffusion. Some useful preliminary relationships between oil-water partition coefficients and permeability constants have been obtained, and approximate values calculated for the permeability of a thin oil layer to hydroxylic compounds. It was emphasized that with polar compounds the resistance to free penetration lies largely in the necessity of breaking hydrogen bonds between polar groups and water before penetration of the external oil-water interface can occur, and with non-polar compounds the principal resistance lies in the difficulty experienced by hydrocarbons in diffusing from oil into water.

The problem of emulsions was presented by R. C. Pink (Belfast) and A. King (London). The former pointed out that metallic soaps are poor emulsifiers unless they act as solid stabilizing agents. There are three essential functions attached to a solid stabilizing agent essential for emulsion stability. The agent must be insoluble in both phases, but must be wetted by both phases, and the particles must inter-associate to form a stable interfacial layer. A metallic soap which can be readily dispersed in oil acts as a solid stabilizing agent if the action of water precipitates it out of dispersion; thus magnesium oleate gives excellent water-in-oil emulsions, whereas zinc or nickel oleate give no emulsions.

A. King stressed the importance of the interfacial film on the stability of emulsions in general as measured by the change of area of the interface with time. Emulsions stabilized by agents such as soaps give much finer emulsions than those stabilized by solids such as alumina, but the former are easily influenced by the presence of salts and temperature, whereas the latter are stable against most conditions, such as salts, temperature and *p*H. The effect of salts of the lyotropic series on emulsions stabilized by saponin are interesting. Thus sulphates increase both stability and viscosity, whereas thiocyanates and iodides markedly reduce these properties of the emulsions.

J. Powney and L. J. Wood (London), in conclusion, brought to the attention of the meeting the interesting fact that whereas electrophoretic mobility of droplets and interfacial surface tension both depend on the formation of interfacial films, in a number of cases no correlation apparently exists between the two phenomena. Thus over very small concentrations of the salts of long-chain sulphates and amines, great changes in electrophoretic mobility (of oil droplets) are observed with no measurable change of interfacial tension. Only over the range of concentration where the electrophoretic mobility is nearly constant does the interfacial tension seem to change in any marked degree.

OBITUARIES

Mr. D. Ward Cutler

THE death of Donald Ward Cutler, head of the Microbiological Department at the Rothamsted Experimental Station, came as a sudden and unexpected shock to his colleagues. He had been at his work as usual, then was suddenly struck down with pneumonia and survived only a few days. He was trained in zoology at Cambridge under Prof. Stanley Gardiner, and after his happy and successful undergraduate years at Queens' College he went to the Marine Biological Station at Plymouth to investigate fish scales. In 1915 he joined Prof. S. J. Hickson's staff at Manchester, where his gift for lecturing and for teaching made him a useful member of the department; in his free time he studied the Protozoa of termites. A weak heart prevented his being accepted for active service, but he gave valuable help in the Pathological Department set up for the Manchester war hospitals and became an expert on amœbic dysentery.

After the War he transferred to Rothamsted to take charge of the microbiological work that had for some time been going on there. His first investigations were on the Protozoa of the soil which had been shown to play an active part in the microbiological processes, and he soon succeeded in clearing up many of the difficulties that had arisen in connexion with them. He confirmed Goodey's observation that the ciliates were probably not very active, and Martin and Lewin's observation that the amœbæ were active, and he showed why amœbæ could not easily be picked out from the soil. In conjunction with L. M. Crump he made daily counts of the numbers of bacteria and of certain Protozoa in the soil of one of the Rothamsted fields, carrying on the work without intermission for a whole year, and so obtained a rich mass of data which has since proved very valuable in soil microbiology. The numbers showed considerable fluctuations from day to day, but the bacteria and the Protozoa fluctuated in opposite directions: when the Protozoan numbers were high those of bacteria were low, and vice versa. This accorded with the view that the Protozoa were acting detrimentally on soil bacteria. Later work, however, showed the operation of another factor: in culture solutions the bacteria generally proved to be more efficient when their numbers were low than when they were high, so that the amount of activity per head of bacterial population was actually increased by the action of the Protozoa.

He also studied the bacterial oxidation of ammonia to nitrate, and showed that this is a commoner property than had been supposed.

In recent years his chief work had been on the purification of effluents from sugar beet and milk factories, an investigation carried out at the request of the Department of Scientific and Industrial Research. He was in charge of the microbiological side and the late E. H. Richards of the chemical side, and the good personal relationships of the two leaders enabled them to bring the work to a satisfactory conclusion. During these investigations much valuable information was accumulated about the decomposition of organic matter by bacteria, and this is now being put together.

Ward Cutler's interests, however, were by no means confined to microbiology. He was an active member of the Councils of the Eugenics Society and of the British Social Hygiene Society, and he wrote two well-known books, "Heredity, Evolution and Adaptation" and "Some Problems in Soil Microbiology". He was also a good lecturer, giving generous service to the Workers' Educational Association and other bodies. For many years, too, he was an enthusiastic supporter of amateur theatricals, wherein he displayed no mean ability. Finally, he had an attractive personality and the great gift of winning the loyal support of his staff.

E. J. RUSSELL.

Prof. D. Robertson

WE regret to record the death of Prof. David Robertson on January 8. He was born on December 26, 1875, and like his grandfather, David Robertson, LL.D., the well-known naturalist of Cumbrae, his bent was scientific. Educated at the Hermitage School, Helensburgh, he studied engineering and electricity in the West of Scotland Technical College and the University of Glasgow, where he gained the Sir John Pender Gold Medal, and where he took the degree of B.Sc.(Eng.). Later he was awarded the degree of doctor of science by his own University in recognition of his valuable research work.

After two years as lecturer in the Bradford Technical College, he worked, on original lines, for thirty-eight years in Bristol, where he became professor of electrical engineering in the Merchant Venturers' Technical College in 1902, and in the Faculty of Engineering in the University of Bristol in 1909. He was chairman of the Western Centre of the Institution of Electrical Engineers in 1916, and president of the Bristol Association of Engineers in 1922.

His twenty-seven publications covered a wide field in engineering, and they reflect his character in attention to detail and accurate observation. It makes the achievement of his work so much the greater in that he was confined to an invalid's chair for the last thirty years of his life.

No doubt his works' training in the shops of Messrs. James White, Ltd., was responsible for his great interest in instruments and clocks. "Electrical Meters on Variable Loads" shows the errors which arise under these conditions. "The Clock and Striking Mechanism for the Great Bell of the University of Bristol" gives details of his own design of striking gear, escapement and system of controlling the rate of the clock by means of wireless signals from Greenwich. "The Stroboscope in Speed Measurements and other Engineering Tests" and "The Separation of No-load Stray Losses in Continuous-Current Machines by Stroboscopic Running-Down Method" deal with the principles and application of the stroboscope, and show how the no-load losses can be obtained with accuracy in machines which come to rest in less than one minute. Papers on other subjects include "The Mathematical Design of Transformers", showing how the cheapest transformer for a given output with specified losses is designed; "A Mode of Studying Damped Oscillations by the Aid of Shrinking Vectors", showing in a simple manner how electrical oscillations, or any kind of vibration, can be represented by a vector rotating with uniform angular velocity and, at the same time, shrinking at a uniform rate, so that its path is a spiral.

In recent years he published a very important series of papers on the whirling of shafts and cognate problems. These did much to explain many puzzling phenomena in the running of loaded shafts, and have received high commendation from the special workers in that field. They are notable in the ingenuity displayed in devising experimental methods, and for the criticism of previous work, much of which was mathematical.

S. HOLMES.

Mr. J. A. Tomkins

WE regret to announce the death of Mr. John Arthur Tomkins. He was born in 1874, and received his early education in London. From the age of fifteen he was apprenticed to a firm of scientific instrument makers, with whom he was connected for many years. Between 1892 and 1898, he attended Birkbeck College and the Royal College of Science, of which he became an associate. At this point he entered the teaching profession at West Ham Technical College, as a lecturer in mathematics and physics, and finally joined the staff of the Bradford Technical College in 1903. There he remained until his retirement in 1939. At Bradford, where he became in fact, if not in recognized status, the head of both the Physics and Applied Optics Departments, his long service has left a lasting memorial.

The skill and knowledge acquired in his youth as an instrument maker went with him during life, and Bradford Technical College is enriched with a number of soundly designed instruments. Tomkins' own interests lay perhaps more in the direction of applied optics than pure physics, and many of his thirty contributions to scientific and technical journals dealt with this side of his work. Such a steady stream of published work from a man overburdened with teaching for so many years, actively working for professional organizations (he had much to do with introducing the Association of Teachers in Technical Institutions into the College), and at the same time administering a double department, is its own tribute to his energy and ability. His outside interests appear to have been few, apart from his membership of the Physical Society and the Institute of Physics, of which he was a founder fellow. Bradford has lost a devoted servant, and the Technical College is severed from one whose thoroughness, strict devotion to duty, and too modest personality were a part of it for nearly forty years.

J. P. ANDREWS.

WE regret to announce the following deaths:

Father G. Alfani, the well-known Italian seismologist, aged sixty-four.

Prof. P. Broemser, professor of physiology in, and rector of, the University of Munich, formerly professor of physiology in the University of Basle, aged fifty-four.

Prof. W. Bulloch, F.R.S., emeritus professor of bacteriology in the University of London, aged seventy-two.

Mr. S. H. Hamer, C.B.E., secretary during 1911–34 of the National Trust for Places of Historic Interest or Natural Beauty, on February 6.

Prof. R. von Ostertag, formerly director of the Veterinary Department of the German Ministry of Health and of the Veterinary High School, Berlin.

Prof. Vittorio Patti, director of the Rizzoli Institute and professor of orthopædic surgery in the University of Bologna.

Dr. Cresswell Shearer, F.R.S., formerly University lecturer in embryology, Cambridge, on February 7.

NEWS AND VIEWS

Lord Moyne: New Colonial Secretary

THE announcement of Lord Moyne's appointment as H.M. Secretary of State for the Colonies in succession to the late Lord Lloyd will be welcome to all who have at heart the future of the populations of Britain's colonial dependencies. His experience both in and out of office when as the Hon. Walter Edward Guinness he sat in the House of Commons, and his first-hand acquaintance with colonial problems, will secure that even the nation's supreme war effort will not be allowed completely to obscure the claims of the populations, and more especially the backward populations, of Britain's colonial dependencies, nor the measures which have already been initiated for raising the standards of living and health to fall entirely into abeyance, however difficult that task may be. It will be remembered that not only was Lord Moyne head of the financial mission which visited Kenya in 1932, but he was also chairman of the Royal Commission which investigated conditions in the West Indies in 1938. It was on the publication of the report of this Commission and largely in consequence of its findings that the Government initiated its present policy of colonial development through liberal grants from the Imperial Exchequer over a period of years. Lord Moyne's first-hand acquaintance with the problems of backward peoples is not, however, limited to his official relations with them. He has travelled extensively in remoter parts of the world, and the ethnographical objects collected by him, more especially in New Guinea, have added valuable material to the national collections in the Ethnographical Galleries of the British Museum.

Geological Survey of Eire: New Director

MR. D. W. BISHOPP has been appointed director of the Geological Survey of Eire. He received his training in the Geology Department of the Imperial College of Science and Technology, London, and graduated A.R.S.M. in mining geology in 1923. Developing observations made during his field training in Norway, he published his first paper, one dealing with the Sulitelma pyrite deposits, in the *Transactions of the Institute of Mining and Metallurgy*, and in 1924 was awarded the Institute's Student's Prize. He has had wide experience as a mining geologist, having served with the Mazapil Copper Co., Mexico, the African Manganese Co., Gold Coast, etc. In 1928, he was appointed geological curator in the Rhodesian Museum at Bulawayo, and in 1936 he proceeded to British Guiana as Government economic geologist. His publications have dealt with the mineral deposits of Norway, Mexico and especially British Guiana. The appointment of Mr. Bishopp foreshadows a thorough investigation of the mineral possibilities of Eire.

Cyrene: Birthplace of Eratosthenes, 276–196 B.C.

THE advance of the Imperial armies to Cyrene recalls the time when that city was a home of learning and the capital of Pentapolis, a tract of country containing the five cities Cyrene, Arsinde, Berenice, Ptolemais (or Barce) and Appolonia. Cyrene was the birthplace of several learned men, among whom was Eratosthenes, the geometer and mathematician. A personal friend of Archimedes, Eratosthenes was educated at Alexandria and Athens, and for the greater part of his life was in charge of the University library at Alexandria. He was, says Ball, the Admirable Crichton of his age. He constructed instruments which were used for centuries at the University of Alexandria, suggested the calendar in which every fourth year contains 366 days, determined the obliquity of the ecliptic, measured the length of a degree on the earth's surface and attempted to determine the circumference of the earth. In old age he lost his sight, and starved himself to death at the age of eighty-two.

Early Exploration of Kent's Cavern

THE REVEREND JOHN MACENERY, foremost of the early explorers of Kent's Cavern, was born at Limerick in 1797 and was chaplain to the Cary family at Tor Abbey, Torquay, where he died on February 18, 1841. His stone monument is in the cemetery of the Parish Church of Torre, and it states "he inspired respect as a scholar by the vigor of his understanding, his polished taste and varied learning". He made his first visit to Kent's Cavern in the summer of 1825 by chancing to hear a friend express his intention of joining an exploring party there which eventually numbered about a dozen; he made the last of the train, the others spread themselves about but added nothing to what was already known of the cavern, and he betook himself alone to a spot which seemed to have been disturbed. He tumbled it over and found the first fossil teeth he had ever seen; he pursued his search in silence and kept his good fortune to himself, as he "was anxious to send them in the state they were found to Oxford", probably to Prof. Buckland who later in the year visited Kent's Cavern with MacEnery. On that occasion the latter found the tooth of a rhinoceros and a flint blade which he believed was the first ever found in the Cavern.

MacEnery evidently intended to publish his work as he issued a paper as follows: "Shortly will be published, in one volume Quarto, Cavern Researches; or Discoveries of Organic Remains, etc., etc.", but it is likely that he was dissuaded from pursuing the matter as he might come up against ecclesiastical authority. His most interesting finds were the teeth of Machairodus (sabre-tooth) of which he found about eight specimens. These were the first ever found in Britain and were much prized. He also gathered thousands of specimens of the usual cave fauna as well as flints. Unfortunately, after MacEnery's death the whole of his collections were dispersed by auction, and as the Torquay Natural History Society was founded three years after that date there was no local effort made to keep all his treasures in Torquay, with the result that most of them were purchased by the British Museum and only a few are now in the local museum built by the Society.

Great headway was made between 1865 and 1880, when a very careful exploration of Kent's Cavern was made by a committee of the British Association in which Mr. William Pengelly took the leading part. This resulted in the collection of a very large number of specimens which after supplying the Torquay Museum allowed for the distribution of cave material to many other museums in Britain. The finding of another Machairodus tooth by Pengelly was very satisfactory as there had been some who doubted that MacEnery's had come from Kent's Cavern. Pengelly, by his finding Chellean and other flints, was also instrumental in backing up many of MacEnery's surmises and theories. During the winter of 1925 a Committee of the Torquay Natural History Society was formed to work with a Committee of the British Association for carrying on explorations at the Cavern, and in 1926 a commencement was made at a point selected by the late Prof. Sollas; work has been going on each winter since then up to the present year. In one chamber a depth of thirty-four feet of cave earth has been reached and many fine specimens of flints, teeth and bones have been met with; but the name of MacEnery, the pioneer, is never forgotten.

The American Public and Natural History

ALTHOUGH some aspects of museum activity fail to interest the modern public, the enormous influence of the American Natural History Museum, New York, is cited by Charles Russell in its journal, *Natural History* (Dec. 1940). Statistics show the Museum has: 2,000,000 annual visitors, including its Planetarium; 25,000,000 contacts by its Department of Education; 624,000,000 hour-listening to its radio programmes; 1,000,000 learners taught by its education staff; 200,000 miles a year travelled by museum trucks making 40,000 deliveries to schools, hospitals, prisons, colleges and universities; 480,000 visitors to Bear Mountain trailside museums; 35,000 orders for loan materials outside New York, and 27,000 subscribers to its journal. "The real work of the Museum," states Russell, "is to help people become more aware of themselves and of their surroundings, to help them think in terms of realities, not theories."

When the director of the Museum, Dr. Roy Chapman Andrews, writes a popular animal story about a domestic cat, and the assistant curator of vertebrate palæontology, Edwin H. Colbert, can write an equally engaging story about the sabre-tooth tiger, as is done here, science makes enormous strides in educating the public in palatable, yet truthful, biology. Under "Portrait of a Mammalogist" is given the career of H. E. Anthony, who since 1911 has travelled 200,000 miles collecting for the museum exhibits; the department of mammals, of which he is curator, controls nine of the Institution's twenty-eight exhibition halls with approximately 150,000 specimens. His work on South America's early fossil mammals has been particularly conspicuous and tends to substantiate the theory that up to about 600 million years ago the northern and southern continents were joined by a land bridge even broader than the present central American corridor. American museums seem to be unhampered by that unscientific worship of tradition and the past which leaves many of the smaller British museums without any very useful function in present times.

Life-cycle of Wilson's Petrel

IT is seldom that knowledge of a life-history which has baffled observation for sixty years has been completed so thoroughly as in Brian Robert's account of Wilson's petrel, *Oceanites oceanicus* (British Graham Land Expedition, *Sci. Rep.*, 1, No. 2, 1940). Three seasons observations at a locality easily accessible and easily worked from the northern base-hut in the Argentine Islands, afforded material for a full description of breeding habits and development, and comparison of populations on different island groups has led to the recognition of four sub-species. These populations show no plumage distinctions and differ only in the mean of their measurements, the birds becoming progressively larger in higher latitudes. Incubation is shared by both sexes, which take alternate spells of about 48 hours, and hatching takes place in about six weeks. Thermograph records of the temperature within a burrow during incubation and the growth of the nestling show great steadiness, independent of the variations of the outside atmosphere. Mortality of chicks is high, about 65 per cent succumbing, most often on account of starvation due to the blocking of the burrows by snow. The migrations of Wilson's petrel are among the longest known, for these Antarctic-born birds visit the British Isles and Newfoundland, the Red Sea and Persian Gulf, New Guinea and Northern Peru; and yet ringing of individuals has shown that they return each year to the same mate and the same burrow in the Antarctic. During migration between May and October a complete moult of plumage takes place. Many other matters of interest are dealt with in this valuable monograph.

Scenic Aspects of the Weather

WE are indebted to Mr. L. C. W. Bonacina for an illuminating essay upon a difficult subject written at a time when researches in pure knowledge are of necessity few ("The Place of Scenery in the Study of the Weather and Climate". By L. C. W. Bonacina. *Q. J. Roy. Met. Soc.*, 64, No. 287, October 1940). It must not, however, be supposed that this class of work—and especially examples which have to do with feeling as well as thought—are unimportant at the present moment. On the contrary, it is very desirable that contemplative intercourse with Nature should be cultivated during the exasperating experiences of war. Moreover, when we look ahead to the years that will follow the cessation of the present conflict, we see with certainty that the financial restrictions of the times to come can be countered to a considerable extent by concentration on those refined pleasures of the mind and senses which the æsthetics of scenery provide. The present paper is important for its treatment of scenery as a subject in which all the senses (not only the sense of sight) are concerned; and also for the detailed description of particular incidents in which the author observed those charms which landscape owes to certain transient, but recurrent, aspects of the weather.

Electrical Development in Iraq

THE series of articles dealing with various export markets of the world appearing in the *Electrician* includes one dealing with electrical development in Iraq (*Electrician*, December 6). For the last twenty years this has been mainly concerned with the provision of small generating plants designed to supply power and light to firms and for highways. Until seven years ago there was no sign of any intensive activity, but from 1933, development has taken place in Bagdad, Basra and Mosul. For all intents and purposes, Bagdad is the trading centre of the country, but since the extension of the Turco-Syria railways to the Iraqi frontier at Tel-Kotchek, Mosul is tending to develop an independent commercial life of its own. Incidentally, this extension of the railway, in late 1936, is playing a most useful part in the development of a hitherto minor market. At the moment, however, this line is not completed, so that it is not yet necessary for travelling agents to visit Mosul, nor is it necessary to appoint separate agents for this district. It is possible, none the less, that both these steps will have to be taken as soon as the railway is in full operation.

The growth of electricity in Iraq is reflected in the trade returns for electrical machinery and apparatus. For 1935 the total value of imports under this head was £141,846; in 1936 they showed a value of £198,391, and in 1937 a slight drop to £189,972. The figures for 1938 rose again to produce a total of £242,322. Of these figures Germany supplied £11,495 in 1935, £17,294 in 1936, £25,683 in 1937, and £31,795 in 1938. The shares falling to United Kingdom manufacturers over the same period were £103,289, £132,918, £106,525 and £130,859 respectively. Competition has been particularly strong from Germany in the case of heavy oil engines as the prime movers for generating sets. Here Germany had increased the lead she had gained in the years 1936–38. Analysing the figures shows that in dynamos and motors the supply is mainly from the United Kingdom. In 1937 imports in this class were valued at: United Kingdom £15,199, and Germany £4,218. The battery and accumulator market is shared fairly evenly between the United States and Great Britain. During 1937, imports valued at more than £6000 were supplied by both the United States of America and Great Britain. Imports of electric cables were valued at £25,872, and of this the United Kingdom supplied a total value of £19,584. As regards the development of the country, it is important to note that fuel oil is sold at a very cheap rate, about 2*d*. per gallon, and naturally this is the main source of power. With the exception of turbo-alternator sets in Bagdad, the prime movers for generating sets are oil-burning engines.

War-Time Building

THE design and erection of a war-time building present a number of problems which do not arise in times of peace. These are dealt with in *War-time Building Bulletin* No. 10, just issued by the Department of Scientific and Industrial Research (H.M. Stationery Office. 1*s*.). Since a building erected in war-time is presumably important in the war effort, the following factors over-ride almost every other consideration: (*a*) concealment from the air; (*b*) the minimizing of damage due to aerial bombardment; and (*c*) economy in the use of materials. The bulletin explains, in one document, how to begin tackling these problems.

Olinthus Gilbert Gregory, F.R.S. (1774–1841)

ON February 2 the centenary occurred of the death of Olinthus Gilbert Gregory, who for many years held the chair of mathematics at the Royal Military Academy, Woolwich, and was one of the promoters of the University of London, now University College. He was born on January 29, 1774, at Yaxley, Huntingdonshire, and he owed his first knowledge of mathematics to the Leicestershire botanist and agricultural writer, Richard Weston. At the age of nineteen he published a volume of "Lessons Astronomical and Philosophical", and about the same time, like many of his contemporaries, contributed to the "Ladies' Diary", an almanac and serial collection of mathematical papers, commenced in 1704 by John Tipper, and, like all almanacs, published by the Stationers' Company. His writings brought him to the notice of Charles Hutton, the professor of mathematics at Woolwich, and after a few years spent in teaching, bookselling, and newspaper editing at Cambridge, in 1802 he became a master at the Royal Military Academy, and five years later, on Hutton's retirement, he was made professor, holding his chair for thirty-one years.

Gregory was known as an excellent teacher, and he wrote works on astronomy, mechanics, and trigonometry, translated Haüy's "Natural Philosophy", and from 1802 until 1819 edited the "Gentleman's Diary"—founded in 1741—and the "Ladies' Diary" from 1819 until 1840. In 1823 he experimentally determined the velocity of sound. When, in 1827, the foundation stone of the University of London was laid, his was one of the names inscribed on it. His son, Sir Charles Hutton Gregory (1817–98), a distinguished railway engineer, in 1867 served as president of the Institution of Civil Engineers.

The Royal Military Academy

Apart from the universities and Gresham College, the Royal Military Academy is perhaps the oldest of our institutions, with a long line of notable mathematicians. Woolwich became a naval station as long ago as the time of Henry VIII, and in the reign of Charles II a military depot was established there. In 1741, two hundred years ago, the Academy was founded for the education of cadets, with the German mathematician, John Muller (1699–1784), as headmaster. Two years later, Thomas Simpson (1710–61), who had taught mathematics while working as a weaver in Spitalfields and had published a work on fluxions, was made the professor of mathematics, holding that position until his death. He was a fellow of the Royal Society and a member of the Academy of Sciences, Stockholm. Like Gregory, he edited the "Ladies' Diary", as also did Charles Hutton (1737–1823), the self-taught Newcastle schoolmaster who was appointed to the mathematical chair in 1773. Hutton published many valuable works, and became Copley medallist and foreign secretary of the Royal Society. During the professorships of Hutton and Gregory the staff included for longer or shorter periods John Bonnycastle (1750?–1824), the Rev. Lewis Evans (1755–1827), and his son, Thomas Simpson Evans (1777–1818), and Peter Barlow (1776–1862), who from an obscure mercantile situation raised himself to the front rank of physical investigators. Since the days of these worthies of the eighteenth and early nineteenth centuries, the Royal Military Academy has had among its professors of mathematics many distinguished men, including Samuel Hunter Christie and Sir George Greenhill.

Alexis-Marie Rochon (1741–1817)

Among the less well known of the remarkable group of French men of science who lived through the Revolutionary period was Alexis-Marie Rochon, astronomer, physicist and mechanician, who was born at Brest on February 21, 1741, and died on April 5, 1817. Three years before his death, in August 1814, when Napoleon was an exile in Elba and Wellington was the British ambassador in Paris, Brewster, then aged thirty-two, visited Rochon in Paris, and in his diary for August 22 recorded, "I went this morning to call upon M. Rochon... a venerable and intelligent old man of seventy-three, who is well known to philosophers by his scientific works and inventions. He showed me his prismatic micrometer, a small instrument, with a level for measuring the inclination of lines to the horizon by the coincidence of two images, and his method of doubling the double refraction of Iceland crystal by extinguishing two of the images and employing two that are most remote. . . ."

Brewster and Rochon had much to talk about in optics, but optics was only one of the subjects to which Rochon had made contributions. He had been astronomer-optician to the Marine, had made voyages to Morocco and the Indian Ocean, at Brest he had been librarian to the Royal Marine Academy, keeper of a cabinet of philosophical instruments, the head of a workshop and the first director of the observatory founded at his suggestion. He had made improvements in telescopes, in the wire gauze used in ships' lanterns, and had written on the distillation of sea-water and many other subjects. A member of the old Royal Academy of Sciences, suppressed in 1793, he had been given a seat in 1795 in the newly founded National Institute, and had had a share in the introduction of the new weights and measures, and coinage. When after a long and useful career he died, his seat in the Institute passed to Fourier, and his *éloge* was pronounced by Delambre.

Announcements

Sir Arthur Keith has been elected an honorary member of the New York Academy of Sciences.

Dr. A. B. Walkom, secretary of the Linnean Society of New South Wales, has been appointed director of the Australian Museum.

Canada is setting up a blood "bank" to provide transfusions for 20,000 military and civilian casualties.

The New South Wales Health Department proposes to appeal for at least 10,000 residents of both sexes between the ages of eighteen and sixty to participate in a blood-transfusion scheme to provide a twenty-four-hour service of blood donors to hospitals and doctors and a supply of blood for transfusions in any emergency.

According to the Director of the Census, the population of the United States has increased by 8,634,835 since ten years ago, and is now 131,409,881. This increase is the smallest for any decade since 1790 when the first census was taken. It represents a 7 per cent increase in the population as compared with one of 16·1 per cent between 1920 and 1930, and one of 14·9 per cent between 1910 and 1920. The reasons given for this falling off are (1) a decline in the birth-rate and (2) the virtual stoppage of immigration.

The following appointments in the Colonial Service have recently been made: J. Gordon, assistant conservator of forests, Gold Coast; R. G. Morgan, assistant conservator of forests, Gold Coast; T. I. Rees, assistant conservator of forests, Nigeria; Dr. H. F. Birch, assistant agricultural chemist, Jamaica; M. Park (plant pathologist), divisional and research staff officer, Ceylon.

In Nature of February 1, p. 144, the *Athenæum* was mentioned with the *Gardeners' Chronicle* and *Punch* as having been founded in 1841. This is incorrect. The *Athenæum* was founded in 1828, and Wentworth Dilke, one of the group concerned with establishing the other two journals, was editor during the period 1830–46.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Cultural Significance of Science

IN a communication printed in NATURE of January 25, p. 119, Prof. Polanyi takes issue with an earlier leading article[1] which had urged the rejection of the view that "science is set apart from all other social interests as if it possessed a peculiar holiness". A peculiar holiness, he maintained, is exactly what science does possess. The issue has the appearance of being a fundamental one, since it goes to the root of the whole relation between science and the social order, and some measure of agreement about the nature of this relationship is widely considered to be an urgent need. It may therefore be worth while to point out that this particular example of disagreement seems to be based on a purely verbal ambiguity. In the editorial, "holiness" meant, surely, "having an esoteric character", whereas to Prof. Polanyi it clearly meant "having overwhelming ethical value". I, for one, and there are certainly many like me, would not agree for a moment to deny the ethical value of the scientific method; but also do not feel quite confident against the accusation that it has in the main been applied to an unduly narrow range of phenomena. Have we too often exerted ourselves to take an unbiased view of something which is so recondite that there is no adequate reason why the ordinary man should have any view of it, biased or not?

"Scientific detachment", writes Prof. Polanyi, "is of the same character as the independence of the witness, of the jury, of the judge". But the witness, the jury and the judge turn their attention to problems presented to them as being socially important; they are not at liberty to choose to spend the afternoon discussing the sexual habits of Polynesian worms, or whatever else takes their fancy. The Editors of NATURE were, as I understood them, inviting us to spend more time investigating subjects as banal but relevant as crimes. Doubtless it is not altogether easy to preserve scientific detachment in such matters; and one can expect that what are generically termed "powerful interests" will attempt to influence scientific statements on matters of social consequence. But Prof. Polanyi's pessimistic assumption that such influences must always be successful in their nefarious work is vitiated by his own example of the persistence of a real and active legal detachment through many centuries of close contact with the turbulent forces of history.

It may be urged that the law, although employing the method of impartiality, is in its content merely the embodiment of the interests of the most powerful social group, and in that most important respect unfree; and it can be argued that a socially directed science, although free to be critical and objective, would have its attention fixed down to problems chosen for it by social forces outside its own control. But speaking as an embryologist of no cash value to anybody, addressing a physical chemist of enormous industrial importance, I should like to ask Prof. Polanyi if something of the sort is not true already. Our civilization is, to some degree, a society and not a mere collection of individuals. Men of science are, again to some degree only, involved in the social bonds which create the coherence of society. One could only be justified in calling for a less degree of involvement in those bonds if one disapproved of the society as a whole; if, for example, one was a revolutionary who wished to stay outside it so as to overthrow it.

C. H. WADDINGTON.

Christ's College,
Cambridge.
Feb. 1.

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[1] NATURE, 146, 815 (1940).

Science and Government

THE recent communication by R. H. F. Finlay[1] represents a point of view which seems to have some currency at the present time: the right of 'science' to govern. Is not this a threat to freedom? Since the foundation of science is the confession of truth, should we not admit that divided counsels are the breath of science; that not 'certainties' but hypotheses and theories form the stuff of science; that the conclusions of science are no more than provisional opinions based on evidence; that men of science have the virtues and vices of the politicians, trades unionists, lawyers, business men, peers and prelates through whom we govern ourselves to-day; that the omniscience proper to the law and so to government is foreign to science; and that the part of science in the government (a part for which there is unbounded scope) is the provision of knowledge? For if 'science' assume authority, and the current beliefs of science have the force of law, freedom of opinion must perish and truth be shackled indeed.

V. B. WIGGLESWORTH.

Hedgeside,
Beaconsfield.
Jan. 31.

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[1] NATURE, 147, 119 (1941).

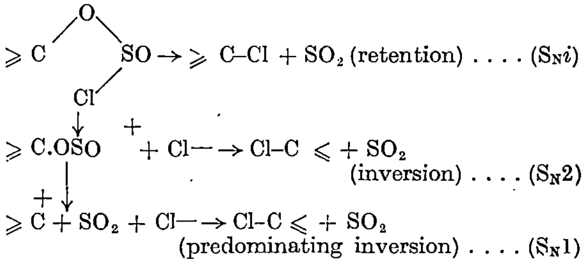
The Walden Inversion in the Replacement of Hydroxyl by Halogen

THE first serious study of the steric course of this replacement was that of Frankland[1], who concluded that phosphorus pentachloride always substitutes with inversion of configuration, whilst thionyl chloride does so except when a phenyl group is attached to the seat of substitution. Although this inference represented a remarkable advance, it is not quite correct, and also requires to be generalized. We have established that all the common substituting agents (PCl_5, $SOCl_2$, HCl, PBr_5, etc.) produce inversion unless a sufficiently powerful assembly, critical for each reagent, of electron-releasing groups at the seat of substitution reverses this result. For example, such an assembly, effective for all the reagents named, is present in the alcohols $CHPhBu^{a}.OH$ and $CHPhBu^{iso}.OH$. (We have carried out an improved resolution of the former and a new resolution of the latter.)

Kenyon, Lipscomb and Phillips first noticed[2] that in structures in which thionyl chloride ordinarily substitutes with retention of stereochemical form, it will substitute with inversion in the presence of sufficient pyridine. This is likewise a special form of a more general result, and we have in fact generalized it to include other substituting agents. For example, it applies to the action of phosphorus pentachloride on the two alcohols mentioned above.

Kenyon and Phillips attributed their phenomenon to the liberation of chloride ions[3], and, leaving aside details which Balfe and Kenyon have since explicitly modified[4], there is no doubt that they were right in their conclusion. However, because Gerrard[5] has cast doubt on their interpretation by emphasizing complications which we should not expect it to cover, we desire to direct attention to a recent general discussion of the problem, and to new observations on an aspect of it which is apparently in opposition, and is actually, in a certain sense, complementary to that illustrated in the phenomenon of Kenyon and Phillips.

In our discussion[6] we assumed that the first step in these substitutions is the formation of a condensation product or 'complex' such as $\geqslant$ C.O.SO.Cl, which can either eliminate the halide ion afterwards responsible for bimolecular or unimolecular substitution (S_N2 or S_N1), or, given a sufficiently facile electron-release from carbon to oxygen, can eliminate an oxide, thereby effecting an internal substitution (S_Ni); known principles determine how the stereochemical result depends on the mechanism followed:


(retention) . . . . (SNi)
(inversion) . . . . (SN2)
(predominating inversion) . . . . (SN1)

The effect of pyridine is explained as a competition of the type S_Ni *versus* S_N2; although the entity substituted in the S_N2-process, which the pyridine promotes, might be $\text{R.OSO}\overset{+}{\text{P}}\text{y}$ or R.OSOCl rather than R.OSO +, and analogously for other complexes. Thus halide ions produced by decomposition with a base promote substitution with an inversion of configuration.

But now, in the absence of a base, and in the presence of a good solvent for carbonium ions, we ought to be able to set up the alternative competition S_Ni *versus* S_N1. Let us consider the effect of chloride ions in this case.

With this object we refer to a recent demonstration[7] that reactions dependent on a preliminary rate-controlling ionization can with certainty be diagnosed when it is possible to observe that the anion produced, by participating in a reversal of the ionization, depresses the rate of the measured reaction. Applying this principle to the present problem, we see that, provided the ionization of the complex is rate-controlling, chloride ions, by reversing this ionization, can favour reaction S_Ni, and thus promote substitution with a retention of configuration.

Using several alcohols of the correct structural type and various substituting agents, we have set up the contemplated conditions by operating in liquid sulphur dioxide, chloride ions being supplied in the form of either triphenylmethyl chloride (a strong electrolyte) or tetraethylammonium chloride: the predicted effect has been observed repeatedly. For example, the alcohol $CHPhBu^{a}.OH$ and phosphorus pentachloride in sulphur dioxide gave $CHPhBu^{a}Cl$ with a rotation $+ 16{\cdot}5°$, whilst a comparative experiment in the presence of only 0·012 *M*-triphenylmethyl chloride yielded $CHPhBu^{a}Cl$ of rotation $+ 87{\cdot}7°$; the positive sign of $\alpha^{20°}_{D}$ ($l = 1$) corresponds to a retention of configuration.

Comparing this effect with that produced by bases, one understands that chloride ions may quite reasonably do opposite things in different circumstances, and this emphasizes the danger of discussing such phenomena from too limited a viewpoint. Our full results will be published later.

E. D. Hughes.
C. K. Ingold.
I. C. Whitfield.

University College,
London,
at Edward Davies Chemical Laboratories,
Aberystwyth.
Jan. 24.

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[1] *J. Chem. Soc.*, **103**, 725 (1913).
[2] *ibid.*, 415 (1930).
[3] Cf. *ibid.*, 382 (1931).
[4] *ibid.*, 463 (1940).
[5] *ibid.*, 218 (1940).
[6] Cowdrey, Hughes, Ingold, Masterman and Scott, *ibid.*, 1252 (1937).
[7] Bateman, Church, Hughes, Ingold and Taher, *ibid.*, 961 *et seq.* (1940).

Viscosities of Three Classes of Liquids

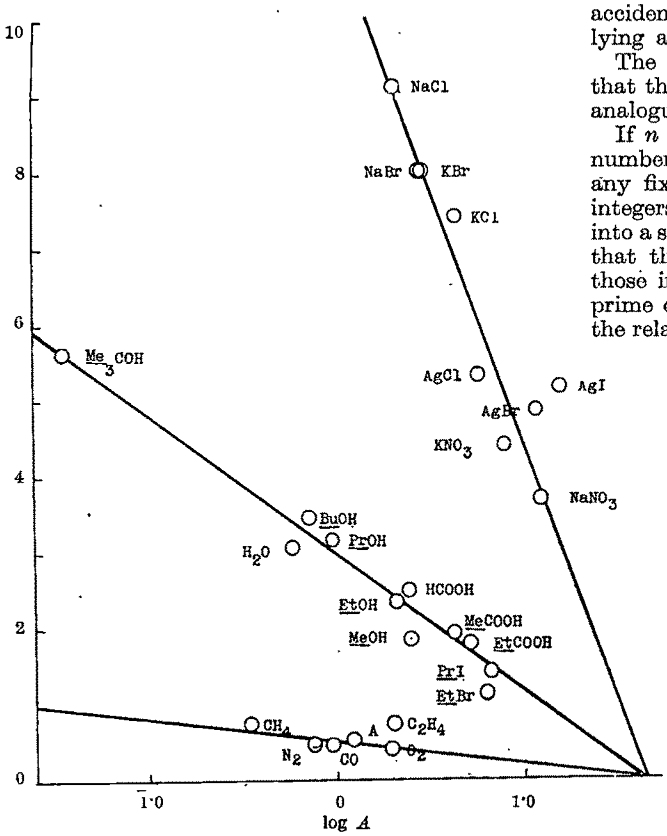
The variation of the viscosity of a great number of liquids can be expressed by Guzmán's equation[1]

$$\eta = A\, e^{B/RT}. \qquad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The values of the constants *A* and *B* for many liquids have been given by Ward[2]. It is now found that an approximately linear relationship holds between the values of *B* and log *A* (Fig. 1). Ionic liquids, hydroxylic liquids, and non-polar liquids have representative points close to three separate straight lines which appear to have a common origin (1·65, 0) on the log *A* *versus* *B* graph. Hence

$$B \cong m(1{\cdot}65 - \log A), \qquad . \quad . \quad . \quad . \quad (2)$$

where *m* is a different constant for each of the three classes of liquid. The graph points for the four alphyl halides cited by Ward (*loc. cit.*) lie just below the line



for the hydroxylic liquids ; two of these points are shown in the graph. The data given by Ward for metallic liquids do not follow equation (2).

Since B is an energy term which corresponds roughly to the latent heat of fusion, equation (2) recalls the energy and entropy relationships found for other properties of liquids[3].

GEORGE NOVELLO COPLEY.

85 Christopher Way,
Liverpool, 16.
Jan. 3.

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[1] *Anal. Fis. Quim.*, **11**, 353 (1913).

[2] *Trans. Farad. Soc.*, **33**, 88 (1937).

[3] Latimer and Buffington, *J. Amer. Chem. Soc.*, **48**, 2297 (1926). Latimer, *Chem. Rev.*, **18**, 348 (1936). Evans and Polanyi, *Trans. Farad. Soc.*, **32**, 1333 (1936). Butler and Reid, *J. Chem. Soc.*, 1171 (1936). Bell, *Trans. Farad. Soc.*, **33**, 496 (1937). Barclay and Butler, *Trans. Farad. Soc.*, **34**, 1445 (1938). Campbell and Eley, *Trans. Farad. Soc.*, **36**, 854 (1940).

Statistics and Prime Numbers

EINSTEIN's statistical theory of Brownian motion has two aspects, one dealing with distribution in time, the other with distribution in space. It is known[1] that, while the spatial distribution is described, as in the chronology of a Geiger counter, by Poisson's enumerating law of independent rare events, the temporal distribution turns out to be determined by the classical theory of independent frequent errors. Precisely in view of the latter theory, and in view of the ergodic hypothesis, the spatial distribution requires a more specific model than does the temporal distribution ; the former dealing with accidental fluctuations, the latter only with the underlying average state.

The object of this note is to point out the fact that this ambivalence in distribution has a complete analogue in the theory of prime numbers.

If n is a positive integer, let $\nu = \nu(n)$ denote the number of its distinct prime divisors, where m is any fixed positive integer or zero. If all positive integers which exceed unity are thought of as parcelled into a sequence of 'urns' $U_0, U_1, \ldots$ in such a way that the urn U_m contains the infinite sequence of those integers which possess exactly $m + 1$ distinct prime divisors, then the ratio $\pi_m(n) : (n-1)$ supplies the relative frequency ('probability') of those integers which are in the m-th urn and do not exceed n ; while $\nu(n)$ represents only a single cross-section of this infinite sequence of information.

The result corresponding to the normal distribution law in the theory of Brownian motion is represented by the following limit statement, which goes back to Hardy and Ramanujan and was recently proved in its sharper form by Erdös and Kac[2] : *If the deviation is measured on the scale of* $(\lg \lg n)^{1/2}$, *the distribution of the deviation of* $\lg \lg n$ *from the arithmetical mean of the values attained by the function* ν *of* n *on the range up to* n *tends to the symmetrical normal distribution of unit standard deviation, as* n *increases indefinitely.*

In view of the apparent parallelism between the average Brownian state and its accidental fluctuations on one hand and the single function $\nu(n)$ and the sequence of functions $\pi_0(n), \pi_1(n), \pi_2(n), \ldots$ on the other hand, the answer to the delicate problem concerning the distribution over the various urns $U_0, U_1, U_2, \ldots$ instead of the average distribution of their 'cross-section', will be expected to run as follows : *The positive integers not exceeding* n *are distributed over the various urns* $U_0, U_1, U_2, \ldots$ *in such a way that, in accordance with the law of independent rare events, the distribution is asymptotically represented by the Poissonian law of standard deviation* $(\lg \lg n)^{1/2}$, *if* n *increases indefinitely.* It will now be shown that this statement is correct, and that it is, as a matter of fact, a mere restatement of the prime number theorem.

A distribution over a sequence of discrete 'events' is called Poissonian if there exists a positive number λ such that the probability of the realization of the m-th event is proportional to $\lambda^m/m\,!$, where m varies through all positive integers and zero. Clearly, the factor of proportionality is $e^{-\lambda}$. The standard deviation is known to be $\lambda^{1/2}$. If the m-th event is represented by the presence of a positive integer in the m-th urn, U_m, where the positive integer is chosen at random among all positive integers not exceeding unity, then the relative frequency of the m-th event is $\pi_m(n) : (n-1)$, provided that the positive integer is restricted to be not greater than n.

Accordingly, the statement is that this relative frequency becomes asymptotically proportional to the Poissonian probability $e^{-\lambda}\lambda^m/m!$, where the standard deviation, $\lambda^{1/2}$, is stated to be $(\lg \lg n)^{1/2}$, while m is arbitrarily fixed. In other words, what has to be verified is that if m is arbitrarily fixed, $\pi_m(n)$ is asymptotically proportional to $n(\lg n)^{-m}/n\,!$. But it is shown by a well-known elementary calculation, which was apparently first carried out by Gauss[3], that if this asymptotic proportion is true for the particular index $m = 0$, then it is true for every fixed m. Since the asymptotic proportion reduces for $m = 0$ to the prime number theorem[4], the proof is complete.

AUREL WINTNER.

The Johns Hopkins University,
Baltimore.
Dec. 23.

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[1] Cf., for example, Borel, E., and Deltlieil, R., "Probabilities-Erreurs" (Collection Armand Colin, No. 34, art. 67 and art. 66; 1934).

[2] Erdös, P., and Kac, M., "The Gaussian Law of Errors in the Theory of Additive Number Theoretic Functions", *Amer. J. Math.*, **62**, 738–741 (1940).

[3] Gauss, C. F., "Werke", **101**, 11 (1917).

[4] Cf. Ingham, A. E., "Distribution of Prime Numbers". (Cambridge Tracts in Mathematics and Mathematical Physics, No. 30.)

Rust-Resistant Wheats for Egypt

OUR results resemble those obtained by Mehta and Pal[1] in India so closely that we are prompted to report them here.

All three rusts of wheat occur in Egypt, but the greatest loss in yield is caused by black rust on *vulgare* wheats in the Delta; our data indicate that the average annual loss is not less than 10 per cent of the possible yield, or about 2½ million bushels. The barberry plays no part here in the annual recurrence of black rust, for it is not found in or near Egypt, and wheat plants are so rarely found in summer that it is unlikely that they carry over the rust. Air-borne spores of black rust have, however, been found coming from the north-west[2] and it may be that this is the main source of infection.

Indian *vulgares* are better suited to Egyptian conditions than any other imported wheats (with the exception of one Italian variety Mentana), and Egyptian *vulgares*, known as Hindi wheats, are of Indian origin. Hindi and Indian wheats have all been found to be highly susceptible to black rust in Egypt, and interspecific crossing was thus resorted to in an attempt to obtain a resistant *vulgare*. We have produced a moderately resistant *vulgare* variety Mabrook from Giza 7 (*vulgare*) × Beladi 42 (*pyramidale*) which gives about 17 per cent higher yield than Hindis in the Delta, mainly because of its increased seed size and weight.

A large number of imported varieties have been tested for their resistance to black rust in Egypt, and as was the case in India we have found some *vulgares* with a promising degree of resistance in a group of Kenya wheats kindly supplied by the Director of Agriculture, Kenya, and by the Director of Plant Breeding, Department of Agriculture, New South Wales, Australia. Under Egyptian conditions these varieties are poor yielders and, according to our requirements, have other undesirable characters.

Since 1936 we have been crossing them with Egyptian wheats and we have obtained some F_4 and F_5 lines which are very resistant, give high yields and possess other desirable characters. *UX9M1A3* (Kenya) crossed with Giza 7 has given lines which are more resistant than the parents and in fact are almost completely resistant. Giza 7, from Federation × Indian 7, is less susceptible than Hindis and is our best quality Egyptian wheat. The Kenya parent shows quite a high degree of resistance, and we are informed that it is of unknown hybrid origin. We find that it has a gene for waxless foliage which is the dominant allelomorph of a gene for waxy, whereas waxy is usually dominant to waxless in *vulgare*. This indicates that it may have arisen from an interspecific cross, obtaining the dominant waxless and its rust resistance from the tetraploid parent.

The physiological races of black rust in Egypt have not been determined, but the above evidence suggests that they may be the same as those found in India.

The discovery of resistant *vulgares* has simplified our problem, and it appears that already we have made good progress towards the production of a resistant variety which is suited to Egyptian conditions and requirements.

JAMES PHILP.
A. G. SELIM.

Plant Breeding Section,
Ministry of Agriculture,
Giza.
Dec. 1.

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[1] Mehta, K. C., and Pal, B. P., NATURE, **146**, 98 (1940).

[2] Jones, G. H., Bull. No. 146, Egyptian Min. of Agric. (1935).

Riboflavin in Black Pepper

Fixen and Roscoe[1] quoting Murthy[2] place the fresh green berries of *Piper nigrum* extraordinarily high in the list of riboflavin-containing materials. Commercial black pepper, which consists of the dried berries of this plant also picked in the green stage, was considered as a possible source of riboflavin. When this product was assayed for riboflavin by the method of one of us[3] it was found to be devoid of riboflavin. An aqueous extract gave a very strong green fluorescence at high dilutions, but the solubility properties of the fluorescent material were not those of riboflavin but were similar to those of piperine. That this is the substance in black pepper which is responsible for the observed green fluorescence is confirmed by the strong fluorescence obtained with purchased piperine at a dilution in water of 1 in 2 million. Piperine in alcohol solution gives a light blue fluorescence with ultra-violet light, and in chloroform a purple blue fluorescence is seen. The fluorescent material in black pepper behaves in a similar manner to piperine, whilst riboflavin gives a green fluorescence in both water and alcohol, and luminoflavin fluoresces green in alcohol, chloroform or water solutions.

Murthy uses an isolation method based on adsorption on fullers' earth, and admits the desirability of confirming the high value which he obtained for pepper by animal tests. We are of the opinion that when dealing with material of unknown fluorescent behaviour it is advisable to define riboflavin as a substance with a green fluorescence which is insoluble in chloroform and which after exposure to ultra-violet light in $N/2$ sodium hydroxide becomes chloroform-soluble without loss of fluorescence.

G. E. SHAW.
H. G. HIND.

Evans Biological Institute,
Runcorn,
Cheshire.
Jan. 16.

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[1] Fixen and Roscoe, *Nut. Abs. & Rev.*, **9**, 795 (1940).

[2] Murthy, *Ind. J. Med. Res.*, **24**, 1083 (1937).

[3] Shaw, *Quart. J. Pharmacol.*, **12**, 541 (1939).

RESEARCH ITEMS

Upward Movement of Soil Solutes in Plants

THERE is now satisfactory evidence that solutes can move up the wood alone in amounts approximating those moving in intact stems, but the evidence concerning movement in bark is scarcely so satisfactory. A re-examination of this latter point has recently been made by Mason and Phillis (*Ann. Bot.*, N.S. 4, 765; 1940). Sea Island cotton plants are approach grafted and the weaker top removed, leaving a plant with one top and two root systems, one the 'main' root and one the 'side' root. The plants are grown under conditions of nitrogen starvation up to the time of the experiment, when the main root is immersed in solutions richer in nitrogen and the side root in a calcium sulphate solution. In one set of plants a half-inch ring of phloem is removed between the fork and the side root, and a half-inch segment of wood from between the fork and the main root. In a second set ('normal') the stem between the fork and the side root is severed. Both sets therefore receive adequate water, and nitrogen is absorbed only by the main root. All plants are harvested after five days and analysed for nitrogen and for bromine, which was also added to the culture solution bathing the main roots. Both sets are compared with an initial collection. Increase in both nitrogen and bromine is found to be significant in the plant as a whole and in the tops, for both 'normal' plants and 'cut wood' plants. Uptake was, however, considerably diminished in the latter group. Only traces of bromide entered these plants, so that this ion must travel with difficulty in phloem. With nitrogen, although translocation to the top was considerably diminished in amount by the wood 'ring', about the same *proportion* of the nitrogen absorbed by the plant reached the tops as in normal plants. Nitrogen therefore passes up the bark alone at a rate approximating that in bark plus wood. Previous work has shown the same statement to be true also for wood alone. It is impossible to say which channel is most used by normal intact plants.

Structure of the Apple Cortex

W. H. SMITH (*J. Pom. and Hort. Sci.*, 18, 249; 1940) has investigated the relations between the size of a mature apple, size and number of cells in the fleshy tissues, its level of respiratory activity and its keeping quality. It is concluded that the histological structure of the cortex of different varieties is related to their physiological behaviour. Apples with a longer growing season were found to have a smaller number of constituent cells in unit weight of tissue and a greater degree of cell enlargement, associated with relatively low respiration rate and good keeping quality. In short-season varieties there was a larger number of smaller cells, high respiratory activity and more rapid rate of senescence. The amount of cell multiplication varied with variety and largely determined typical fruit size. Within a variety, average cell size was correlated with the weight of the mature fruit, larger apples having larger cells. The number of cells was also greater in larger apples than in smaller ones of the same variety. Fruit size at maturity was thus determined both by amount of cell multiplication and degree of cell enlargement.

Nodule Bacteria and their Hosts

THE relative efficiency of nodule bacteria which attack leguminous plants has a very marked effect upon crop yield. Several factors appear to affect this efficiency, and H. K. Chen, Hugh Nicol and H. G. Thornton have recently investigated the part played by root juices of the host plant (*Proc. Roy. Soc.*, B, **129**, 475; 1940). Cultures of the nodule bacteria from soy bean and pea were treated with such juices obtained from plants with effective and with ineffective nodules. Extracts from roots with effective nodules produced a significant improvement in growth of the bacteria in a substantial number of the experiments. Juice from roots with ineffective nodules depressed the growth-rate of the bacterial cultures in several experiments, but the rate of increase of the different bacterial strains with root juice from uninoculated, nodule-free plants was not correlated with their effectiveness. It is evident that relations between the bacteria and their host are not always harmonious, and it is suggested that, as a result of infection, the plant produces soluble substances in its roots which, through their effect upon bacterial growth, can determine the relative efficiency of nitrogen fixation.

Pests of Garden Vegetables

G. FOX WILSON contributes a timely paper upon "Some Seasonal Pests of Garden Vegetables" to the *Journal of the Royal Horticultural Society* (**65**, Pt. 12; Dec. 1940). This reflects the author's flair for grouping pests according to their effects or their control, and is mainly written for growers of food. The economic entomologist will, however, find a little new documenting of his subject, such as a map showing relative distribution frequency of the cabbage white fly, *Aleurodes brassicæ*, in England and Wales, a photograph of a shaker blower for the application of nicotine dust, and a description of 'bloated' onions infected with the bulb eelworm, *Anguillulina dipsaci*.

Mutation Effects of Ultra-Violet Light

K. Mackenzie and H. J. Muller (*Proc. Roy. Soc.*, B, 1929, **691**; 1940) provide important data on the effects of ultra-violet light on *Drosophila melanogaster*. It is shown that the most effective wave-lengths for the production of gene mutants lie between 320 and 300 *m*γ, which correspond to those absorbed by nucleic acid. The incidence rate of gene mutants and structural alterations was studied in the same individual, and the authors' earlier results were confirmed that ultra-violet light, unlike X-rays, are ineffective in causing gross rearrangements in structure. Preliminary evidence indicates that minute alterations in structure are also rarely produced by ultra-violet light. This fact leads to important conclusions such as: (1) minute deletions and gene mutations are probably distinct; (2) activation of nucleic acid by radiation can give rise to gene mutation, but is ineffective in producing structural rearrangements; (3) the size of the gene may not be measured by ionization quanta since gene mutations occur secondarily as the result of a transfer of energy from nucleic acid as the primary effect. The atoms of the gene itself are not ionized specifically and directly by the ultra-violet light. The authors suggest that the relationship, if any, between cancer and gene mutations and ultra-violet light might be investigated with advantage in the light of this knowledge.

The Cheviot Granite

THE results of a recent detailed study of the Cheviot granite by A. G. Jhingran were communicated to the Geological Society at the meeting of January 22. The granite occupies an area of 22 square miles, but owing to a thick covering of peat and drift exposures are poor. Three main types are recognized: (*a*) the marginal variety, fine-grained and dark, with abundant plagioclase; (*b*) the Standrop variety, forming the central part of the area, relatively coarse-grained and light, with dominant orthoclase and abundant quartz; (*c*) the granophyric variety, containing biotite, occupying the ground between the others. Types (*a*) and (*b*) are pyroxene (diopside and hypersthene) granites. They contain numerous fine-grained inclusions which are composed of the granitic minerals, but with larger proportions of biotite and pyroxene. Chemically, a typical example falls at the silica-poor end of the variation diagram of the granitic types. The lavas around and included within the granite have been metamorphosed; but they seem to have caused little modification of the granite, if any. The variability of the granite is nevertheless probably due to contamination, but by Silurian greywacke and shale. A process of simple differentiation seems to be inapplicable, and no field evidence suggesting emplacement by successive injections has been found.

Mica in Tanganyika

THE pegmatitic mica deposits of the Uluguru Mountains, first discovered by Stuhlman in 1894, were successfully worked by the Germans until hostilities began in 1914. Under the direction of a British Military Board the industry was restarted in 1917. In subsequent years much prospecting was carried out and other important sources of mica—mainly of muscovite—were discovered. In 1920 the Government disposed of the various claims and private individuals began to operate, peak production being reached in 1925. Since then the industry slowly dwindled until 1937, when a revival set in. There are ample resources to meet a wide range of demands, and in order to stimulate further developments a report on the subject has recently been issued which makes available full information as to the geology of the mica fields and the conditions and requirements concerning prospecting, mining, grading and preparation, and marketing (G. J. Williams and A. F. Skerl, Tanganyika Terr. Dept. Lands and Mines, *Geol. Div. Bull.*, Dar es Salaam, 14, 47; 1940). The mica-pegmatites are restricted to rocks of the Lower Basement Complex, through which they are distributed fairly uniformly. It is noted that there is no spatial relationship between the pegmatites and either the older granites or the later central granite batholith of the Territory. This constitutes a serious objection to the traditional view that such pegmatites represent the residual fractions of granitic magmas. The authors favour the rheomorphic hypothesis and suggest that the pegmatites have been formed from palingenetic fluids, generated in depth, which may have migrated through a considerable vertical distance before deposition took place. Particulars are also given of lepidolite, in greisen-like pegmatite; phlogopite, associated with crystalline limestone or pyroxenite; fuchsite, a constituent of schists and quartzite; and vermiculite, associated with pegmatites cutting ultra-basic rocks.

Stability of Emulsions

EARLIER workers on emulsions regarded the interfacial electrical potential as an important factor in relation to the stability, but later work with protected emulsions indicated that the protective film of emulsifying agent conferred stability of the droplet in the emulsion; other recent workers believe that electrical conditions play a dominant part, but in some cases the emulsifying agents were liable to react with many of the electrolytes employed. A. King and G. W. Wrzeszinski (*J. Chem. Soc.*, 1513; 1940) have studied the influence of electrolytes on stabilized oil-in-water emulsions. No relation was observed between the electrical charge and emulsion stability in cases where chemical reactions were absent. The stability is ascribed to the properties of the film of emulsifying agent which surrounds each particle, which is generally strongly hydrophilic and, owing to hydration, is stable even at the isoelectric point. In the action of salts the effect of the anion is preponderant and is determined by its position in the lyotropic series. The destabilizing effect of any given salt on a particular emulsion is apparently due to the disruption of the absorbed film of stabilizing agent. There is nothing to differentiate between the stability of the film and of the emulsion. The concentration of the internal phase in the emulsion is also important in determining the stability in presence of electrolytes.

Internal Temperature of White Dwarf Stars

IN an important paper (*Astrophys. J.*, 92, 321; 1940), R. E. Marshak investigates in detail the probable condition of matter in the cores of the white dwarfs Sirius *B* and 40 Eridani *B*, with the view of deciding how the radiation from such stars is maintained and how they are likely to evolve in the future. Energy transport is found to be chiefly by radiation in the non-degenerate envelope; but by electronic conduction in the degenerate core. The free-electron density and the pressure are calculated for the radiative envelope, for the core, and for the intervening transition region; and then the equations of stellar equilibrium are numerically integrated through the surface regions and on into the interior. For Sirius *B* the thickness of the non-degenerate envelope and the internal temperature are calculated for various assumptions regarding the chemical constitution of the star: the envelope is found to extend over only 6 per cent of the radius at most, while the central temperature is found to be about 15×10^6 degrees C. for a Russell mixture of elements. At this temperature reactions between protons and other nuclei would go on very rapidly, and since the luminosity is so low, a negligibly small upper limit is deduced for the concentration of hydrogen in the core. This is true whether the source of energy is the carbon cycle or the proton-proton reaction. It is therefore concluded that the transmutation of hydrogen cannot account for the observed production of energy; thermonuclear processes are abandoned as the main source of energy, and recourse is had to the old gravitational-contraction theory, which gives a lifetime of at least 10^8 years before the white dwarfs cease to radiate visibly.

TELECOMMUNICATIONS TECHNIQUE AND BROADCASTING RECEIVERS

TWO papers which would, in normal circumstances, have been presented at the December and January meetings of the Wireless Section of the Institution of Electrical Engineers are now available. The full papers will be published in the June issue of the *Proceedings* of the Wireless Section, while extended abstracts are contained in the January issue of Part I of the *Journal of the Institution*.

The first of these papers is entitled "The Application and Use of Quartz Crystals in Telecommunications" and its author is Mr. C. F. Booth, of the Radio Branch of the Post Office Engineering Department. The piezo-electric crystal has played a major part in the advances which have been realized in telecommunications during the past ten years, and without its aid many radio-frequency generation and selection problems could not have been solved. Of the several crystalline substances possessing the piezo-electric property, quartz, tourmaline and Rochelle salt have been used in various phases of communications technique. The British Post Office has been actively concerned for many years with both the application and production of the quartz oscillator and resonator, and Mr. Booth's paper presents an account of this work and directs attention to some of its more important applications.

For the production of electrical oscillations of very stable frequency, whether for laboratory purposes or for the control of radio transmitters, the quartz crystal oscillator provides the simplest solution when a specific frequency in the range 50–200,000 kc./s. of stability better than $\pm 100/10^6$ is required, and it is almost the only solution for stabilities better than $\pm 10/10^6$. The type of quartz oscillator now in use has a frequency-temperature coefficient of less than $\pm 2/10^6$ per degree centrigrade, and while the output power obtainable from such an oscillator is small, this may readily be amplified up to the highest powers required for radio transmitting purposes. Much of the success of the widespread use of radio communication rests upon the ability so provided of maintaining radio transmitters upon their allocated frequencies within narrow tolerances. For example, a feature of present-day broadcasting involves the operation of several transmitters on the same frequency. Such transmitters may not vary in frequency by more than 1 c./s., and such stability has only been obtained in practice by means of a quartz oscillator control. In addition to such applications, the quartz crystal element may be associated with suitable electrical circuits to provide radio-frequency filters of a very high selectivity.

The chief source of good natural quartz is Brazil, and the selection and testing of such raw material and the production therefrom of suitably cut crystals for radio purposes is a highly specialized art. The paper referred to above includes a well-illustrated section describing in some detail the methods employed in the crystal laboratory of the Post Office for the production, adjustment and testing of quartz oscillators and resonators for use by that department in its many and widespread activities in the field of telecommunications. It is visualized by the author that the quartz crystal will play an increasingly important part in the ever-growing technique of communications.

The second paper is entitled "Broadcast Receivers: a Review"; and its authors, Messrs. N. M. Rust, O. E. Keall, J. F. Ramsay, and K. R. Sturley, are members of the staff of Marconi's Wireless Telegraph Co., Ltd. This paper comprises a review of broadcast receiver circuits and developments over the ten-year period from 1929 up to the outbreak of war. The first part of the paper has been compiled from an examination of more than a thousand circuit diagrams, and is a review of such receiver circuits which have stood the test of production. The broadcasting receiver is analysed stage by stage in the paper with the aid of typical diagrams, in an attempt to extract the salient technical features. It would appear, however, that as the sales market over the period under consideration consisted mainly of purchasers of first receivers, the trend of design was influenced by selling points rather than basic principles and potential users' needs.

Recognizing the limitations referred to above, the second portion of this paper is concerned with some fundamental problems and the lines of possible future development. Selectivity, fidelity, electrical interference and automatic accessory circuits for volume, frequency, selectivity and remote control are some aspects of receiver design to which attention is devoted. Up to date, two specifications, which attempt to define and assess the performance of broadcasting receivers, have been produced; one was first published in 1930 by the Institute of Radio Engineers in the United States, and has since been modified and extended; the second was published in Great Britain in 1936 by the Radio Manufacturers' Association. Such specifications were, however, found to be inadequate, and when happier times return they will have to be drastically revised to meet the needs of the broadcasting receiver industry.

The concluding portion of this paper refers to the difficulties accompanying the allocation of wavelengths to broadcasting stations, and the prevailing congestion in the long and medium wave bands. With the view of meeting these difficulties, there has been a tendency to urge the advantages of broadcasting over telephone lines and electricity supply networks. The authors point out, however, that the position might be ameliorated to a considerable extent if the channel width utilized was related to the programme requirements. Thus, instead of using uniform channels of 9 kc./s. nominal width, it would be preferable to allot a single side-band channel of 5 kc./s. for speech, and a 20 kc./s. double side-band for programmes requiring high quality. In such cases, transmitter and receiver design would need to be correlated, and opportunities for exploring this possibility may occur in the future.

DEEP-FOCUS EARTHQUAKES OF THE SOUTH-WEST PACIFIC

R. C. HAYES, of the Dominion Observatory, Wellington, New Zealand, read a paper on deep-focus earthquakes of the south-west Pacific at the Sixth Pacific Science Congress in 1939.* The Dominion Observatory at Wellington has for many years carried out the determination of provisional epicentres in the region south of the equator, lying between long. 140° E. and long. 160° W. In the region investigated, it appears that about 11 per cent of all the earthquakes have abnormally deep foci, and that about 60 per cent of the deep ones occur between lat. 10° and lat. 30° S.

It is found that the deep-focus earthquakes occur in most parts of the general seismic belt extending south-eastward from near the coast of south-eastern Asia, through New Guinea, the Solomon Islands and the New Hebrides to the region of Fiji, Tonga and Samoa. The belt of both normal and deep earthquakes thence appears to turn southward toward New Zealand, although the deep earthquakes apparently become less frequent as the New Zealand region is approached. There is no evidence of a continuation of this belt across the South Pacific toward South America, but there is a short extension north-eastwards to Samoa.

The occurrence of deep-focus earthquakes near the Kermedec Islands and New Zealand has been confirmed. According to Hayes, the earthquakes of October 30 and November 1, 1938, with epicentres north-east of Taupo in the North Island, had focal depths of the order of 200 km. Present evidence indicates that the western Pacific deep-focus belt, after turning southward from the Fiji region toward New Zealand, probably terminates just east of New Zealand in about lat. 42° S., or at least is interrupted at this point for a distance of about 400 miles.

Wadati, Berlage and Davison have previously noticed that in Japan, Manila (East Indies) and South America respectively the depth distribution of deep-focus earthquakes appears to increase in the 'continental' direction. Hayes states that the data so far available do not show very clearly whether this type of distribution exists in the south-west Pacific except in the Fiji region, where depths are definitely greater on the 'continental' side of the earthquake belt than on the Pacific side.

An important feature which Hayes has observed in some deep-focus earthquakes in the south-western Pacific is the remarkably large amplitudes sometimes recorded at Wellington of the phases *ScS* and *sScS*. When these are both observed, they provide a comparatively accurate method of determining focal depth.

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* *Bull.* S. 59, Dom. Observ. Wellington. Proc. Sixth. Pac. Sci. Congress, 1939.

FESTIVALS OF THE MIN CHIA, YUNNAN

RELIGIOUS festivals of the Min Chia, a non-Chinese tribe of Yunnan, have been described by C. P. Fitzgerald (*Man*, December 1940) to illustrate that their acceptance of Chinese culture, in so far as religious belief and practice are concerned, is less complete than outward appearance would indicate. While the Min Chia in fact are acquainted with a form of Buddhism, they worship a number of non-Buddhist deities and practise the rites of ancestor worship ; but it is not correct to say that they have three religions. In practice the worship of the Buddhist Boddhisatvas and Taoist deities forms one religion served by the same rite—burning incense before the shrine—and attended by the same people, usually women and girls. It may be contrasted with ancestor-worship, in which women take a less active role, and which is a private family affair without public festivals or temples.

Of the ancestral ceremonies, one of the most elaborate is the Shu Bao or "burning the bundles", which takes place on the 15th day of the 7th lunar month (in 1937, August 19) for the purpose of dispersing the ancestral spirits after their annual sojourn of fourteen days in the home. It takes its name from the burning of bundles of 'books' of Chinese poems, on each of which is inscribed the name of an ancestor, to a total number of perhaps one hundred individuals, extending back to the tenth generation.

A festival characteristic of the worship of local deities is the Gwer Sa La, a dance festival held in the villages along the lake north of Ta Li on the 25th of the fourth lunar month (May) between the gathering of the wheat harvest and the transplanting of the rice seedlings. Young men dancers, arrayed in costumes in some ways suggesting those of women, pass through all the villages on the lake shore, dancing at each, singing and acting in a half-intoxicated manner, both they and the spectators behaving boisterously. The last dance is always in the Mer Ger Yu village, and after a feast the dancers disperse, before the last act of the festival in which the tablet of the ancestor of this village is carried in procession in a litter to a spot a mile distant at the edge of the village lands, where the arrival of the last body of dancers is awaited. All return, the dancers dancing continuously, to the village, and after a final dance the tablet is returned to the temple and a feast follows.

The meaning of the rite is obscure, though it is said to be intended to bring benefit to the rice crop. The dancing at this feast is identical with the performance of a class of exorcists known as *sai dser*, which may mean "westerners".

FORTHCOMING EVENTS

Tuesday, February 18

Institution of Civil Engineers (Joint Meeting with the British section of the Société des Ingenieurs civils de France) (at Great George Street, London, S.W.1), at 1.30 p.m.—M. Tony Jules Gueritte: "Further Data concerning Pre-Stressed Concrete: Comparison between Calculated Stresses Registered during Tests".

Wednesday, February 19

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. Julius Grant: "Art and Science in Paper Manufacture".

Geological Society of London (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Dr. E. Greenly: "The Glacial Phenomena of Arron". Mr. B. C. King: "The Cnoc na Cuilean Area of the Ben Loyal Igneous Complex".

Friday, February 21

Institution of Mechanical Engineers (at Storey's Gate, London, S.W.1).—Annual General Meeting. Lt.-Col. P. H. Johnson: "The Mechanical Requirements of the Royal National Lifeboat Institution".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Two Assistant Lecturers in Mechanical Engineering at the Ipswich School of Engineering—The Secretary for Education, Tower House, Ipswich (February 21).

Lecturer in Mathematics and Science at the Chesterfield Technical College—The Clerk to the Governors, Technical College, Infirmary Road, Chesterfield (February 22).

Vice-Principal at the Arab Women's Training College, Palestine—The Secretary (I.P.R.), Board of Education, Alexandra House, Kingsway, London, W.C.2 (February 24).

Graduate Lecturer in Mathematics and Physics at the Burnley Municipal College—The Director of Education, Education Offices, Burnley (February 24).

Principal of the Shrewsbury Technical College—The Secretary for Education, Education Office, County Buildings, Shrewsbury (February 26).

Director of Education to the Isle of Wight County Council—The Clerk to the County Council, County Hall, Newport, Isle of Wight (February 26).

Lecturer-in-Charge, Department of Coal Mining, Technical Education Branch, Department of Public Instruction, and a Lecturer upon Coal-Mining Engineering, etc., University of Sydney—The Official Secretary, New South Wales Government Offices, 125 Strand, London, W.C.2 (February 28).

Principal of the Salisbury Diocesan Training College for Women Teachers—The Hon. Secretary, Diocesan Training College for Women Teachers, The Close, Salisbury (March 1).

Headmaster of the County School for Boys, Beckenham and Penge—Mr. G. Crease, 12 Beckenham Road, Beckenham, Kent (March 8).

Demonstrator in the Departments of Chemistry and Pharmacy—The Registrar, Portsmouth Municipal College, Portsmouth.

Assistant Engineer by the Government of Dominica (British West Indies)—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9551).

Engineer for the Public Works Department of the Government of Sierra Leone—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9552).

Engineering Assistants at the Air Ministry—London Supplementary Register Office, Ministry of Labour and National Service, 4 Great Marlborough Street, London, W.1 (quoting Order No. 472).

Lecturer in Mechanical Engineering and Two Lecturers in Electrical Subjects at the Rotherham College of Technology and Art—The Director of Education, Education Offices, Rotherham.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ollsgoil na h-Eireann (The National University of Ireland). Calendar for the Year 1939. Pp. ix+344+674+452. (Dublin: National University of Ireland.) [91

London Shellac Research Bureau. Technical Paper No. 19: Lac-Cellulose Lacquers. By Dr. B. S. Gidvani and Dr. R. Bhattacharya. Pp. 24. (London: London Shellac Research Bureau.) [91

University of London: University College. Calendar, Session 1940–1941. Pp. lxiv+576+lxv–lxxix. (London: Taylor and Francis, Ltd.) [91

Air Ministry: Meteorological Office, London. Southport Auxiliary Observatory (the Fernley Observatory of the Corporation of Southport). Annual Report and Results of Meteorological Observations for the Year 1939. By George A. Lidster. Pp. 32. (Southport: Fernley Observatory; London: Air Ministry.) [91

Institution of Gas Engineers. Publication No. 234: 1st Report of the Chairmen's Technical Committee, 1939–1940. Pp. 24. Publication No. 237: Second Arthur Duckham Research Fellowship Report—The Radiation from Solid Substances under Flame Impact, Part 1. By E. C. W. Smith. Pp. 36. (London: Institution of Gas Engineers.) [91

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 9: Oak Galls in the *Historia Plantarum* of Theophrastus. By Prof. Gustav Senn. Pp. 343–354+1 plate. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.). 2*s*. [91

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 801, Vol. 239: The Soft X-ray Spectroscopy of Solids. By H. W. B. Skinner. Pp. 95–134. 6*s*. 6*d*. Series B: Biological Sciences. No. 572, Vol. 230: The Flight of the Dipterous Fly *Muscina stabulans* Fallén. By F. S. J. Hollick. Pp. 357–390. 5*s*. No. 573, Vol. 230: The Devonian Fish *Palæospondylus gunni* Traquair. By J. A. Moy-Thomas. Pp. 391–414. 7*s*. (London: Cambridge University Press.) [91

Other Countries

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 39: Studies on the Preservation of Fruit Juices, 2: Experiments on the Preparation and Preservation of Unfermented Apple Juice. By Lal Singh and Dr. Girdhari Lal. Pp. 24. (Delhi: Manager of Publications.) 14 annas; 1*s*. 3*d*. [91

Government of Travancore. Administration Report of the Government Museum, 1114 M. E. Pp. ii+8. (Trivandrum: Government Press.) [91

Union of South Africa: Department of Agriculture and Forestry (Division of Chemical Services). Bulletin 213 (Chemistry Series No. 160): Survey of the Most Important Tobacco Soils of the Union of South Africa. By Dr. J. L. Steenkamp. Pp. 74. (Pretoria: Government Printer.) 6*d*. [91

Publications of the Observatory of the University of Michigan. Vol. 8, No. 2: Spectrophotometric Determinations of Stellar Temperatures, 4: An International Comparison of Standard Lamps. By Robley C. Williams. Pp. 37–44. (Ann Arbor, Mich.: University of Michigan.) [91

Report of the President and of the Treasurer for the Year ended September 30, 1940. Pp. 184. (New York: Carnegie Corporation of New York.) [91

Bulletin of the American Museum of Natural History. Vol. 77, Art. 8: The Post-Glacial History of *Zonotrichia capensis*. By Frank M. Chapman. Pp. 381–438. (New York: American Museum of Natural History.) [91

Publications of the University of Sydney, Department of Zoology. Monograph No. 1: The Plankton of the Australian Coastal Waters off New South Wales. Part 1: With special reference to the Seasonal Distribution, the Phyto-Plankton, and the Planktonic Crustacea, and in particular, the Copepoda and Crustacean Larvæ, together with an account of the more frequent members of the Groups Mysidacea, Euphausiacea, Amphipoda, Mollusca, Tunicata, Chaetognatha, and some reference to the Fish Eggs and Fish Larvæ. By Dr. William J. Dakin and Alan N. Colefax. Pp. 215+4 plates. (Sydney: University of Sydney.) 21*s*. [91

Catalogues, etc.

The *Industrial Chemist* Diary for 1941. Pp. 20+Diary. (London: The *Industrial Chemist*).

The Nivoc Supplement. Special War Issue No. 4, December 1940. Pp. 16. (London and Birmingham: W. and J. George, Ltd., proprietors of F. E. Becker and Co.)

Mathematics, Astronomy, Physics, from the Library of the late Prof. A. E. H. Love. (No. 89.) Pp. 40. (Oxford: Parker and Son, Ltd.)

College Diary, 1941. Pp. 32+Diary. (London: South-West Essex Technical College and School of Art.)

Calendar for 1941. (Newcastle-upon-Tyne: C. A. Parsons and Co., Ltd.)

The B.D.H. Vena-Flask and its use in Intravenous Therapy. Pp 20. (London: The British Drug Houses, Ltd.)

Instruments for the Measurement of High Vacua—The Vacustat. (Mes. la.) Pp. 2. (London: W. Edwards and Co. (London), Ltd.)

A Catalogue of Books: Alchemy, Astrology, Chemistry and Allied Subjects; Botany; Early Medicine and Surgery; Addenda. (No. 584.) Pp. 40. (London: Bernard Quaritch, Ltd.)

Calendar for 1941. (Newcastle-upon-Tyne: C. A. Parsons and Co., Ltd.)

The Wild-Barfield Heat-Treatment Journal. Vol. 4, No. 27. Pp. 23–34+iv. (Watford: Wild-Barfield Electric Furnaces, Ltd.)

Conti-Glo Fluorescent Decoration. Pp. 4. (Cleveland, Ohio: Continental Lithograph Corporation.)

The Use of Crystalline Vitamin B_1 Thiamin Chloride (Thiamine Hydrochloride U.S.P. XI) in Foods. Pp. 8. (Rahway, N. J.: Merck and Company, Inc.)

Kodak X-ray Direct Reading Localizer. Pp. 4. Kodak X-ray Materials and Accessories. Pp. 16. (London: Kodak, Ltd.)

Catalogue of Books relating to Egypt Ancient and Modern, including Egyptian Sudan. (No. 12.) Pp. 38. (London: George Salby.)

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CO-ORDINATION OF THE NATION'S RESOURCES

RECENT debates in the House of Commons on man-power and production have indicated an increasing concern with the direction and co-ordination of our economic effort. The announcement that Lord Stamp has reported to the Prime Minister that the work of surveying economic and financial plans which he undertook with the assistance of Mr. H. G. Henderson and Prof. Henry Clay can now be brought to an end, suggests that a definite stage has been reached in this matter.

There are, of course, fields in which economic affairs, as in that of economic warfare, overlap with considerations of offensive warfare itself; with our comparatively limited resources of man-power its apportionment between war production, essential services, civil defence and those of the highly mechanized armed forces is no simple matter. Without, however, a clearly defined policy and accurate knowledge, waste and overlapping are almost inevitable.

Of the danger of departmentalism the Ministry of Aircraft Production provides a sufficient illustration. Despite the wonders Lord Beaverbrook worked last summer in accelerating the production of fighters, his methods have as conspicuous defects as merits. Refusal to co-operate or co-ordinate, and war with other departments as well as on the Nazis, are no service to our total effort when they upset the programme of other departments. Moreover, the administrative task is not simply that of balancing or co-ordinating rival demands. It involves the harmonizing of the policy as well as of the programmes pursued by such closely related departments as, for example, the Ministry of Food and the Ministry of Agriculture, or for another example, of the Ministry of Food and the Ministry of Health.

When departmental decisions or policy may affect not only the internal efficiency or purposes of that department but may even impair or frustrate the programme and policy of another independent department, some co-ordination and guidance from above is clearly demanded. Nor is this the whole difficulty. Our economic policy or strategy must have regard not merely to affairs in Great Britain but also to the economic position of the Dominions and Colonies, and of our allies and well-wishers in other countries. Nothing less than the maximum and most efficient use of the full economic resources of the whole Empire will suffice for our success in this struggle.

There have already been reminders of these interactions from time to time as restrictions have been placed upon imports of foodstuffs or other commodities. The recent decision of the Government to reduce or prohibit imports of fresh or canned fruit are a pertinent example that such matters do not end with our own self-denial. From the point of view of conserving shipping tonnage these may be wise precautions, but their reaction on the countries thus deprived of their markets, such as South Africa and Jamaica, may have a significant effect on the economic front of our total war effort.

Jamaica, for example, is one of the poorest of the British West Indian Colonies, and her poverty will be desperately increased now Great Britain is no longer to take her bananas, which normally account for half her total exports and were almost entirely imported by Great Britain and the now blockaded countries of Europe. A disastrous hurricane and the spread of disease had already badly affected the banana trade last year, and exports in the first half of the year were only a fraction of what they were a year earlier. While the trade has no more than meagre reserves, sugar-rationing has blighted Jamaica's only hope of expansion in an alternative crop, and a food production scheme launched a few months ago has been hampered by the absence of sufficiently attractive prices and by unemployment among the middle classes providing the market for such new output.

This situation can scarcely be ignored by the Secretary of State for the Colonies in view of the recommendations of the Royal Commission on the West Indies which the Government has already accepted, and the policy to which we have been committed by the inauguration of the new Colonial Development Fund. The restriction of these food imports therefore may well involve increasing the substantial British financial help to Jamaica as well as exploring the possibility of outlets for her produce in the Dominions and the United States. Other parts of the Colonial Empire which have been responding so splendidly to the call of the Motherland may also require financial or other help in similar ways as a repercussion of restrictions at present imposed by us on their markets.

The matter is, however, one which has a direct connexion with the plans which the Ministry of Economic Warfare is already formulating for the management of the great surpluses of food and raw materials now accumulating in different countries. These plans are concerned with the problems that will face us when the War is over: the task of meeting the immediate needs of Europe. Within the boundaries of the Empire it should at least be possible to consider them in relation to the financial and economic needs and resources of the Empire at war, and to minimize the dislocation and distress occasioned by the disruption of the individual economy of Colony, Dominion or Motherland under immediate exigencies. Wisely conceived with a view to such policies, the work of the Interdepartmental Committee, of which Sir Frederick Leith-Ross is chairman, appointed by the Minister of Economic Warfare, might well provide the Minister of Food or other colleagues with valuable data enabling them to achieve their own ends with less friction or dissipation of colonial and imperial resources.

This is indeed yet another field in which planning to meet post-War problems may assist in the solution of those of a war-time economy. The Interdepartmental Committee has clearly a double function. Its purpose is to mitigate present embarrassments of overseas producers deprived through the War, whether by the British blockade, food policy or in other ways, of many of their normal markets, as well as to prepare in advance for the relief at the earliest possible moment after their liberation of the plundered countries the resources of which are being ruthlessly drained to serve the Nazi war machine. It should not be forgotten that the appointment of this Committee brings a message of hope to the inarticulate victims of Nazi depredations. Effective publicity in these unhappy countries for the work on which the Leith-Ross Committee has embarked might be far more valuable to the British cause than a premature statement of war aims, and in itself provide a most effective answer to the challenge of the new order or regulation through Nazi domination in Europe which has been so blatantly proclaimed.

The problems which confront the Committee are indeed complex, and the statement on economic warfare broadcast a short time ago by Dr. Hugh Dalton to the United States was framed to invite the co-operation of the United States. While the most immediate problems are those of finance and storage, the eventual problems of shipping and distribution call for consideration in advance, in the light of the experience accumulated after the armistice of 1918. Exact conditions cannot be forecast, but some broad estimate of needs and the points where they are likely to be most acute should not be impossible.

Nor is this all. The problems of future production also intrude themselves. Beyond the immediate needs of Europe lies the larger task of constructing a scheme for co-operative planning which will put an end to the gross inequalities between people and people, man and man, that are the disease of our modern life and the cause of much of our economic confusion. If, indeed, we can solve this problem of surplus production, we may break down the system of high tariffs and other restrictions.

The issues with which the Committee is dealing have indeed more than passing significance. They impinge directly on the world-wide problem of bridging the gap between producer and consumer, of co-ordinating the different types of production suited to different regions and of planning distribution and exchange. As Dr. Dalton put it, we must finish with the economics of scarcity and anarchy; we must build the new economics of plenty founded on a rational plan. To extend the immense productive reserves of the world both to relieve poverty and to create a new standard of living, and in so doing to lift the spectre of unemployment from millions, is a constructive task in which we may well look for the comradeship of the American people.

None the less it is true that along such lines our own efforts should assist eastern Europe to build a life less exposed to the rival ambitions of great Powers and less distracted by the animosities of race. With the breakdown of high tariffs and other restrictions and the use of our common resources to develop the economic life of the poorer States by expenditure on roads and transport, education, co-operative institutions, and schemes of nutrition, eastern Europe should acquire a well-balanced economy in which primary production and industrial expansion are complementary. If we can put courage and imagination into our schemes for reconstruction, democracy, by rescuing eastern Europe, may at once attest its own vitality and superiority to the dictatorships and its claims on the help of the American peoples in these even wider constructive schemes inherent in a world economic plan. Whether indeed we face the immediate problems of our own war-time economy, calling for single-minded direction and co-ordination through a Minister of Economics, or their impingement on the immediate post-war problems confronting the Leith-Ross Committee, the need is for the vision, courage and creative statesmanship which are the secret of every major advance of man.

RECENT TRENDS IN PSYCHICAL RESEARCH

Experiments on the Paranormal Condition of Drawings. By Whately Carington. **Fresh Light on Card Guessing.** By S. G. Soal. *Proceedings of the Society for Psychical Research*, Part 162, June 1940.

The Ultra-Perceptive Faculty
An Experimental Investigation. By Dr. J. Hettinger. Pp. 204. (London: Rider and Co., n.d.) 12*s*. 6*d*. net.

IN the course of the last few years, a change has become apparent in the attitude of serious students in psychical research, not only as regards the nature of the problems with which they are called upon to deal, but also as to the methods by which those problems should be tackled. As progress is made along the whole scientific front, so new methods, devised for specific problems, can often be turned to account in dealing with points the elucidation of which was not envisaged when the novel means of attack were first planned.

The problems of psychical research, as is now sufficiently well known, can be roughly but conveniently divided into two main groups, which are generally called the physical phenomena and the mental phenomena. The former class comprises such occurrences as telekinesis, materializations, apports and such-like; whilst the latter consists of the subjective or psychological manifestations concerned with the various automatisms, trance mediumship and the host of varied occurrences which have often been associated with a supposed telepathic or clairvoyant faculty.

As regards the physical phenomena, it can be said with some degree of truth that very little progress has been made during the last fifty years. Indeed, during recent times frauds and mystifications have become so frequent, and the incompetence and disingenuousness of certain investigators so marked, that many students have turned away in disgust and concentrated all their attention upon the psychological side, where better control conditions can often be secured.

Apart also from the dubious nature of the physical phenomena themselves, the difficulties of obtaining repeatable experiments have proved almost insuperable; and thus accounts of these manifestations have remained on the anecdotal plane, to be appraised for what they are worth, but often of little real interest except for those who view them from the historical or anthropological aspects.

The Society for Psychical Research has always been keenly aware of these weaknesses and difficulties, and so far back as 1883 Prof. F. Y. Edgeworth contributed a paper to the Society's *Proceedings* in which he dealt with the calculus of probabilities applied to this subject. Again, in assessing the value of the successes in the card-guessing experiments conducted by the late Mrs. A. W. Verrall about 1890–95, the formulæ for calculating probability were used by Mr. C. P. Sanger; and for some years afterwards it was always felt that some method for estimating chance factors was urgently needed when dealing with questions in which telepathic and clairvoyant factors seem to have been indicated. It was not, however, until 1928 that Miss I. Jephson published a paper in the Society's *Proceedings* in which she described the results of a series of card-guessing experiments. Although perhaps her data were not sufficiently controlled, her methods of dealing with them had much to recommend them. Statistical theory and technique had progressed since 1890, and Miss Jephson availed herself of the methods of scoring coincidences in tests with playing cards which had been devised by Prof. R. A. Fisher about 1924, and afterwards modified by him in view of the problem presented by the card preferences exhibited by certain persons who offered themselves as subjects for experiment.

The scoring technique devised by Prof. Fisher not only furnished a score where a guess is correct but also a score for a partially correct guess. Thus if the actual card is the ten of clubs and the ten of spades is guessed, then there is a greater degree of success than if the percipient had guessed the queen of hearts. This development of the statistical method as applied to the problems of psychical research is now rapidly proceeding and bids fair to occupy the centre of the controversial stage for some years to come. The turmoil aroused in psychological circles in the United States concerning the question of what has been called 'extra-sensory perception', as formulated by Dr. J. B. Rhine and his colleagues at Duke University, is now becoming crystallized around fewer points, since the attacks on the statistical technique employed have almost entirely failed and the great improvement, both in the soundness of the data and their presentation, have led to a general tendency to view the whole question in a more favourable light.

It is the feeling that psychical research, in order to produce more fruitful and reliable results, must employ quantitative methods to a far greater extent than hitherto, which has inspired the work of Messrs. Carington, Soal and Hettinger, bibliographical details of which can be seen above. How far, it may be asked, are the 'coincidences' so frequently met with in this subject 'real' coincidences, and how often might they be said to happen 'by chance'? Can we obtain a probable chance-frequency by which the results can be judged? Do the figures, if they can be obtained at all, show significant results, or merely a result which, judged purely from the statistical point of view, can certainly be ascribed to what we call 'chance'? In other words, the problem is one where we have to ask ourselves whether the data provided by certain branches of psychical research are analogous, or can be made analogous in all important respects, to those other fields of research where the statistics of probability are generally accepted, such as in questions arising from the consideration of games of chance or experiments depending upon random sampling and suchlike.

In the case of the three authors now under review, the claim is made that experiments have been devised which exhibit significant results, and show clearly that something other than the chance factor is present. In all three cases the most rigorous conditions prevailed, and normal, simple sources of error such as leakage or fraud can, it seems, be safely dismissed. In Mr. Carington's experiments simple drawings were used for the test material. About 250 percipients took part and these were instructed to reproduce the drawings exhibited, normal knowledge of which being, of course, carefully excluded. Other sets of drawings were used as controls, and the scoring was carried out by an independent judge; the results being that the percipients tended to a highly significant extent to score relatively more hits on the original drawings of their own experiment than on the control drawings used in other experiments. A test control scoring of the same set of drawings against a randomized 'dummy' set gave a null result. Moreover, it appeared that the successes were not always of the 'now or never' type, where the hits occurred only on the occasion when the original drawings to which they seemed to refer were displayed. A certain displacement, both earlier and later, was to be noticed, and it was this which suggested to Mr. Soal that he should undertake a re-examination of some of the mass of data on card-guessing which he had collected and which had seemed to yield so little evidence of any non-sensory cognition.

From this examination emerged the discovery that two of Mr. Soal's percipients exhibited in their guesses the same kind of displacement effect remarked by Mr. Carington. Thus in one instance, of 2,000 guesses, the hits on the actual card intended to be transmitted were 447, giving a standard deviation of 17·89 and a value of χ (deviation/standard deviation) of $+ 2{\cdot}627$; the hits on the card before the actual card, 457 (standard deviation 17·53: $\chi = + 4{\cdot}164$); and on the card after the actual card, 442 (standard deviation 17·53: $\chi = + 3{\cdot}309$). In addition to this remarkable effect, of which the interpretation is still obscure, Mr. Soal has shown how the cards before and after the card to be guessed influence the results, thus suggesting that the card images are somehow known to the percipient before they emerge into consciousness.

The psychological implications of these results, which Mr. Soal has discussed in his paper, are obviously of considerable importance, and suggest that links between normal mental action and what is apparently going on during these obscure processes are already beginning to appear. However that may be, the discovery of this displacement effect may have considerable influence when the results of earlier experiments are assessed, since in these cases the investigators were concerned only with successes on the actual card or symbol exhibited, other guesses being generally neglected or reckoned as failures.

The methods pursued by Dr. Hettinger were somewhat different. In his monograph, which has been approved for the degree of Ph.D. by the University of London, he is at pains to show that modern statistical technique can be applied to statements made by mediums concerning objects submitted to them. In each test the items perceived by the medium relating to the subject with whose article he was dealing were presented to the subject for identification, mixed in some way with an equal number of control items, the subjects not knowing, of course, which was which. Six hundred and twenty-three tests yielded 6,631 items or statements; and of the total 13,262 actual and control items, 4,483 were accepted by the subjects as being applicable to them. Of these, 2,570 belonged to the subjects and 1,913 to the control or fictitious items, the result being calculated as 14·6 times the probable error.

Successful criticism of these results must, it seems, be based upon two main sources of suspected error. An attack can be made on the validity of the data upon which the computations are based; or, if this proves abortive, the statistical technique itself can be criticized. Since this technique is comparatively simple and based on well-recognized principles, an attack in this direction would seem to be somewhat hazardous, and recourse must be made to assailing the validity of the original data, evidence being offered to indicate unnoticed sources of error in their collection and treatment. Considering the extreme care and rigorous scrutiny by experts of every step that has been made in most of these experiments, such a criticism would doubtless be welcomed were it to be forthcoming. But it is in the repetition of the experiments by others and on a large scale that progress can best be achieved. Were such repetitions to exhibit the same puzzling features, then these new methods now being used in psychical research would prove to be fully justified, and we might reasonably expect that this exasperating study has at last turned the corner and is gradually passing from the anecdotal stage to that of a well-founded experimental science. E. J. DINGWALL.

POWER-TABLES

British Association for the Advancement of Science Mathematical Tables

Vol. 9: Tables of Powers giving Integral Powers of Integers. Initiated by J. W. L. Glaisher. Extended by W. S. Bickley, C. E. Gwyther, J. C. P. Miller, E. J. Ternouth, on behalf of the Committee for the Calculation of Mathematical Tables. Pp. xii+132. (Cambridge: At the University Press, 1940.) 15*s*. net.

THIS work is based on a table compiled by Glaisher about 1873, giving the first twelve powers of the first thousand integers. Only one copy of Glaisher's table is known to have survived, and it came into the possession of the British Association Tables Committee in 1935. It is not known how Glaisher computed his table, but it is so accurate that, apart from one missing digit, no error has been found in it.

Glaisher's work has now been largely extended. The present volume gives in full the powers of numbers 1 to 99 up to the 30th; the 31st to 39th and 41st to 49th powers of these numbers somewhat curtailed, the 40th powers in full, and the 50th powers of numbers 1 to 120 in full. For numbers above 100 the range of powers is not so great. The largest number dealt with is 1,099, of which the powers up to the 12th are tabulated.

A table of 50th powers is a majestic sight. The curve $y = 50 \log x$ stands out clearly on the page, shaded in by the digits of the entries in the table. Even 2^{50} has sixteen digits, while 120^{50} is a number of a hundred and four digits. Every fiftieth power is congruent to 0, 1, 249, 376, 624 or 625 to modulus 1,000, and these numbers are seen repeating themselves down the edge of the table. The entries do not go far enough to reveal any higher periodic properties.

For actual reading the tables soon get a little monotonous, and the introduction is to be preferred. This gives an interesting account of the methods of computation and checking, and suggests methods of interpolation which could be used. A bibliography gives a list of earlier tables, most of which have been checked by the present calculators, and lists of the errors so found.

E. C. TITCHMARSH.

A NEGLECTED THINKER

The Philosophy of Peirce
Selected Writings. Edited by Dr. Justus Buchler. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvi+386. (London: Kegan Paul and Co., Ltd., 1940.) 16*s*. 6*d*. net.

C. S. PEIRCE was a thinker of rare originality and depth, a logician brought up, as he said, in a laboratory. Nevertheless, though he influenced the development of mathematical logic in his lifetime, his general influence on contemporary thought has been almost entirely indirect, through friends, such as James, Royce and Dewey. His published writings, mostly short articles, have attracted little attention. The present reviewer has to confess that when he read a selection of these reprinted in 1923 under the title "Chance, Love and Logic" he failed to realize their value. Recently the great mass of manuscripts he left has been published, but few are likely to wade through the whole six volumes of his complete works. It is to be hoped, therefore, that this selection of published and unpublished work, with an excellent introduction by the editor, will make his work better known; for it is worth knowing in spite of its peculiar defects. Every now and again Peirce stated an important principle with force and clarity; but when he came to develop and explain it he tended to be pedantic and even confused and irrelevant. He had many of the faults as well as a good deal of the genius of Kant. He also suffered from being fifty years ahead of his time—he died in 1914 at the age of seventy-five. It must suffice here to mention three of his outstanding contributions to thought to be found in this book.

(1) It is often said that Peirce was the originator of Pragmatism; but his theory is not the same as James's. The starting point for Peirce was Alexander Bain's definition of belief as "that upon which a man is prepared to act". When this is applied to scientific belief it means that a theory prescribes certain operations to be performed and states the results that will follow the performance. If the results do not follow, the theory is false. If no kind of operation is prescribed by it, the theory cannot be shown to be false but is superfluous, and may be an obstacle to the formulation of the proper kind of theory. This attitude was novel in the nineteenth century though very generally accepted now. Peirce quite definitely avoided the fallacy of the Positivist or Phenomenalist view which leaves out the vital factor of "operations to be performed".

(2) Peirce was one of the first to realize that chance or randomness is a positive factor in the physical world, not merely a name for ignorance of causes, and that randomness on a microscopic scale is bound to lead to some kind of regularity on a macroscopic scale. Moreover, as he says, "those observations which are generally adduced in favour of mechanical causation simply prove that there is an element of regularity in Nature, and have no bearing whatever upon the question of whether such regularity is exact and universal or not. . . . Try to verify any law of Nature, and you will find that the more precise your observations, the more certain they will be to show irregular departures from the law. We are accustomed to ascribe these, and I do not say wrongly, to errors of observation; yet we cannot usually account for such errors in any antecedently probable way. Trace their causes back far enough and you will be forced to admit that they are always due to arbitrary determination, or chance" (p. 331). This was published in 1892. The general principle, of which Heisenberg's "Uncertainty Principle" is a special case, could scarcely be more definitely stated.

(3) The problem of the validity of inductive generalization has always been the logician's nightmare. Peirce goes to the root of the matter in a way that makes more recent writers on this subject look like mere fumblers. The first point he makes, generally accepted now but not in his own day, is that there is no complete certainty on matters of fact, only greater or less probability. Mathematical certainties are purely formal and would be the same if all facts were different. The second point which nobody else seems to have expressed properly is that the problem of inductive generalization is essentially one of sampling. The value of the information obtained from a sample as a guide to the character of the whole bulk of the material depends upon what we are looking for and how the sample is taken. If there is something in the bulk not revealed, however many samples are taken and by whatever method, then it is permanently latent and therefore negligible. If later samples reveal something that previous samples failed to reveal, the difference must lie in the method of sampling and is a genuine revelation of the character of the material. Where sampling takes the form of measurement, the calculus of errors provides a check on the value of the results, especially as to what improvement is to be expected by making further measurements by the same method. It shows that as a rule quite a small number of measurements properly made are very nearly as reliable as a very large number. Nothing like Mill's Principle of the Uniformity of Nature

is needed nor is it necessary to "postulate" anything. The only kind of *a priori* principle involved is like those put forward by Kant; namely, if anything is true universally of any aspect or part of experience it must be something involved in the conditions under which that experience is obtained. The questions to be asked are: What is known beforehand about the material to be sampled? By what method are the samples obtained and examined? From the answers to these questions we can assess the value of the generalizations in terms of probability. This explains why each inductive argument has to be considered individually on its merits and not in terms of general formal rules; why, though the notion of probability is involved, numerical values cannot be assigned; at the same time it makes clear that there is a common factor involved in all cases and the procedure is not merely irrational.

A. D. Ritchie.

TELEVISION ENGINEERING

Principles of Television Engineering
By Donald G. Fink. Pp. xii+541. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 33*s*.

PRIOR to the War, Great Britain had established a very advanced position in the application of radio communication to television broadcasting. The inauguration by the British Broadcasting Corporation of the London television station at Alexandra Palace in August 1936 marked the beginning of the first public television service in the world. Much scientific research and technical development in this subject were being actively pursued in several other European countries, and more particularly by various commercial organizations in the United States of America. Since the outbreak of war, the public development and application of television to broadcasting has been brought to a standstill in Great Britain, whereas the technique of the subject has continued to be very actively pursued in America during the past eighteen months. There is good reason to believe, however, that when happier times return, Great Britain will be able to recover a place in the front line of television broadcasting. A good deal of the technical work now being carried out for war purposes by radio engineers and physicists will probably find ready application to television problems when peace comes; while the recent demonstration given by Mr. J. L. Baird of television in natural colours indicates that the small amount of experimental work still in progress is already producing fruitful results.

In preparation for the expansion of the radio industry in America from normal sound broadcasting to include the very wide field of television, Mr. D. G. Fink's book, entitled "Principles of Television Engineering", is probably very opportune. The author is the managing editor of the periodical, *Electronics*, which radio workers in Great Britain find so useful in giving them a survey of progress in the United States of the application of electronic devices to radio and other engineering problems.

The television engineer requires a knowledge both of the technique of radio communication at ultra high frequencies, and of the optical problems involved in analysing a picture or scene at the transmitter and rebuilding it at the receiver. Mr. Fink deals with the whole subject within this scope. The historical aspects of the television field are wisely ignored, and a knowledge of fundamental physics and of ordinary radio technique is assumed.

The early chapters of the book deal with the analysis and scanning of the picture, and the principles of the devices used to convert the variations in light intensity into electric impulses. Following chapters describe the nature of these impulses forming the video signal, which after amplification provides the modulation of the radio frequency carrier waves broadcast to the distant receivers. At the receiving end the process is reversed, and the modulation signals are extracted in order to provide the impulses necessary to reproduce the picture on the screen of the cathode ray tube in the receiver. All these subjects are dealt with in a clear and thorough manner, and references are given, mostly but not entirely, to American literature, which will enable the reader to delve deeper into any aspect of the subject in which he is particularly interested.

The last two chapters in the book deal with the practice of television broadcasting in the United States from studio to transmitter, and of the design and construction of receivers. These, together with the appendix, which sets out the nomenclature, standards, and recommended practices drawn up by the American Radio Manufacturers' Association, should make the whole work of considerable value to engineers responsible for the development and expansion of television throughout the world. The production of this volume is quite in accordance with the very high standard normally attained by the publishers.

Textile Testing

Physical, Chemical and Microscopical. By Prof. John H. Skinkle. Pp. x+272. (London: Macmillan and Co., Ltd., 1940.) 15*s*. net.

PROF. SKINKLE'S book will be welcomed by those engaged in the textile industry as well as by teachers of textile technology. The author has had an ambitious aim. He has endeavoured to cover the physical, chemical and microscopical aspects of textile testing. The microscopical section, which deals with the identification of fibres, might with advantage have been illustrated. The physical section describes all the usual physical tests and, indeed, includes several tests which might not normally be expected in a book of this kind. In the chemical section, the author indicates how fibres, both synthetic and natural, may be related in chemical nature to the carbohydrates and proteins respectively, and he has given standard American methods of analysis of synthetic and natural carbohydrate fibres, and of wool and silk.

While the book in many respects may be regarded as a students' working manual, in others it is more ambitious. It outlines, for example, current conceptions of cellulose, wool and silk structure, and it makes abundant reference to the *Journal of the Textile Institute*, in which much modern textile research is published. The book should certainly make a valuable addition to the textile libraries of Great Britain. It is a pity that the diagrams, as, for example, that of the Soxhlet extraction apparatus on p. 159, are frequently poorly reproduced. In any later edition, attention should be given to this point.

Plant Microtechnique

By Donald Alexander Johansen. (McGraw-Hill Publications in the Botanical Sciences.) Pp. xi+523. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 30*s*.

THE author points out that during the past ten years immense strides have been made in microscopical technique and in our knowledge of life-histories, and the present volume is an attempt to sift the mass of information in the literature and to correlate it so as to be of optimum service to laboratory workers. The book is not intended to be an encyclopædia of methods, but succeeds in giving in a readable form full details of a range of procedures which have been selected as the more reliable and generally useful, as the result of tests carried out in the Stanford laboratories. One of the marked features of modern methods is the tendency to use, wherever possible, whole-mount preparations, maceration and smear methods, and thicker in preference to thinner sections; and such points as these receive full attention. Adequate details are given for the making up of the stains recommended, and many useful hints are included as to the optimum thickness of section, time of day for collecting material for special purposes, etc., which may save much time in preliminary tests. Though the author deals to some extent with reagents of American origin, this is not likely to interfere appreciably with the value of the book to users in Great Britain.

The first section of the book gives a general survey of methods of fixation, staining, microtoming and of more specialized techniques used in cytology, whilst the second and larger section shows how these may be adapted as special methods for the various phyla. It is in dealing with Algæ, Fungi and such lower types, where the constructional substances may differ so widely, that the greatest difficulties are encountered in selecting suitable methods of preservation and examination, and it is probably on such points as these that the book will prove of the greatest value as a reference work, especially as the bibliography may also be used if further details are required.

For each phylum some details are given of the life-cycle, suggestions as to methods of collecting, preservation as herbarium specimens or for laboratory purposes, cultural methods and suitable stains. These details apply not only to the more elementary class types such as Spirogyra, Vaucheria, etc., but also so far as possible to such less-exploited types as the Pyrrophyta, Cyanophyta, Fungi Imperfecti, Lichens, etc. In the higher phyla details of staining, thickness of sections for embryo sacs of Gymnosperms and Angiosperms, methods for germinating pollen grains, etc., also include very numerous hints which should prove of the greatest value.

Industrial Solvents

By Ibert Mellan. Pp. xi+480. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 66*s*. net.

THIS is a mine of information; in it may be found the fungicidal action of diacetin, the intensity of the smell of isobutyl mercaptan, the solubility of nitrocellulose in ternary mixtures, and a vast amount of miscellaneous data which it would be exceedingly difficult to locate in the literature. Even in the book itself, the path is not always clear; a table of dielectric constants appears in the middle of a chapter on volatility and toxicity, while other tables and graphs having little or no connexion with the text crop up at intervals. The effect on the reader is the creation of a sense of bewilderment, particularly in the opening chapters, but this is dissipated by the major portion of the work, which is devoted to an excellent account of the properties of some 180 solvents arranged according to their chemical composition. Several pages are allotted to the more important substances and a few lines only to others, but it would seem that very little information has escaped the eye of the author, particularly when solutions of cellulose derivatives are concerned.

After a useful chapter on plasticizers, the book concludes somewhat unexpectedly with a section on graphical expression and interpretation which is so good that the intrusion may be forgiven.

Future editions would be improved by some rearrangement and a more detailed index, but even as it stands, the volume will be found indispensable to every user of solvents. H. E. W.

CYRENAICA: CULTURE AND ANTIQUITIES

ONCE more with the fall of Benghazi and the British occupation of Cyrenaica, the Libyan menace to Egypt is frustrated. For, indeed, the present campaign against the forces of Italy in her North African colonies is but the latest phase in a conflict between the peoples of the Valley of the Nile and the dwellers in the Libyan Desert and on the coastal fringe westward from Egypt, which *mutatis mutandis* has endured intermittently for many a hundred years. So long ago as the thirteenth century B.C., when the Nineteenth Dynasty ruled over Egypt, Pharaoh Menephthah drove back from the Delta the attack of the peoples of the Mediterranean Sea, Achæans and Lycians, Sardinians and Tyrsenians as they are thought to have been, who, in alliance with and under the leadership of Libyan chiefs, sought to overrun the rich lands of the Nile. But such acts of aggression were not entirely one-sided. Long before, under the Twelfth Dynasty, Amenemhat I had sought to extend his empire over Libyan tribes with the object of exacting tribute from the wealth acquired by their control of the caravan routes from the interior. Under the Twenty-second Dynasty the Libyans with Sheshonq, the Shishak of the Bible who besieged Jerusalem, as their first ruler, established a hold over Egypt which endured from 950 until 740 B.C.

That campaigning in Libya in those days was no less strenuous than it was found to be by the British Imperial troops is suggested by the story of the rise to power of Amasis in 572 B.C. His army, when sent on an expedition into Libya, was convinced that it was intended that they should all perish. They rebelled and raised Amasis to the supreme power, displacing Hophra, the ruling monarch.

Since the Italian occupation, the term 'Libya' has been applied to the two provinces of Tripolitania and Cyrenaica. In the latter, the eastern province of Cyrenaica, geographical conditions, which have been made in some measure generally familiar by recent events, have had a marked effect on the history and development of culture of the inhabitants. The dominant features are two great plateaux which rise steeply from a narrow coastal strip, and then slope down to the desert, which the more important, Jebel Akhdar, reaches at a distance of some eighty miles. Its heights are well watered with abundant springs and its good red soil grows good crops of barley, while the Arabo-Berber nomad or semi-nomad tribesmen find here pasture for their herds of cattle, sheep and camels.

Little less important in a cultural context is the Augila depression, which runs by a remarkable series of oases from the Gulf of Sidra, the ancient Syrtes, to the regions of the Upper Nile. It has served as a line of communication and path of cultural diffusion for countless ages ; but in recent years its importance as a line of communication with the interior has declined with the opening of the Khartum Railway. Of the oases traversed, Kufra, a group of five at the head of the Libyan Desert, covering some 7,000 square miles, is the most important ; it is best known, perhaps, on account of the Senussi sect of Moslems, founded in the nineteenth century, who had their headquarters here until in 1928 the Italians occupied the interior, driving them back to the oasis of Jaghbub then recently ceded from Egypt. Of special interest to archæologists is the "lost" oasis of Oueinat, reached by A. M. Hassanein Bey in 1923, where were discovered some remarkable series of rock paintings and drawings which have since been the subject of considerable study and speculation.

The modern indigenous population of Cyrenaica, since the Arab conquest of A.D. 641, is Arabo-Berber, an amalgam in which the Berber tongue has virtually disappeared along with the script which, as inscriptions show, had been evolved but now survives only among the Masked Tuareg of the western Sahara. Physically, the population belongs mainly to the North African type of the Mediterranean race. Indeed, among the theories of derivation of the North African Berber as found farther to the west, one would assign them to an origin in Libya. In their origins the people of Libya would appear basically to have been closely akin to the proto- or pre-dynastic Egyptians, if reliance is to be placed upon the scanty human skeletal remains which have been found and examined, notably at Mersa Matruh.

Archæological evidence may well be regarded as bearing out a close relation with Egypt in early times. Finds of palæoliths of Mousterian type similar to those of Egypt would seem to confirm this view. On the other hand, more intensive exploration and study, such as the Stone Age has received in French North Africa and has been given by Miss Caton-Thompson to the Stone Age cultures of Khargeh, may reveal links by which Libya will be joined in a North African palæolithic complex. In the meantime, for later ages from mesolithic times onward, detailed study of the Oueinat pictographs has not only revealed evidence of a cultural, even possibly a racial, sequence, but also in conjunction with other evidence the possibility of a connexion with north-west Africa, going back to neolithic or even mesolithic times, and of a diffusion of culture from the upper regions of the Nile which must have traversed Libya by the desert-oasis route and cannot fail to have had its cultural effect on the way.

Up to the middle of the nineteenth century, knowledge of Cyrene and the Pentapolis was confined almost exclusively to literary sources. From Herodotus, we learned of its foundation by Battos, its first ruler, as a colony from Therae, in accordance with the behest of the Delphic oracle, after a misunderstanding of the instruction that it should stand "between the waters" had led to an abortive settlement on the island of Plataea in the Gulf of Bomba. This took place in the middle of the seventh century B.C. The city, which was then built on the high ground in the midst of springs, and appropriately and of right was dedicated to Phœbus Apollo, grew to be the greatest of Greek colonies, with Apollonia as its port, after it adopted a constitution framed by Demonax of Mantinea. This constitution divided the people into three tribes and determined the hostility between Greeks and Libyans, which had previously prevailed and which the intervention of Amasis for the Libyans had failed to compose.

The foundation of Cyrene was followed first by that of Barca, then of Hesperides-Berenice (Benghazi) and Arsinoe, with Apollonia making up the five cities of the Pentapolis. Derna (Darnis-Zarine) was a later Ptolemaic foundation. Cyrene, after a period of great prosperity due to commerce, in which at one time the city attained a population of 100,000, was the home of the Cyrenaic post-Socratic school of philosophy: it declined under the Ptolemies, to whom it had fallen as a result of its submission to Alexander in 331 B.C. Trade between Egypt and Carthage, upon which its prosperity had largely depended, was then diverted to the more direct route through Barca. Towards the close of the Ptolemaic rule, Apian gave Cyrenaica to Rome by his will and, with Crete, it was formed into a Roman province. It now had a large Jewish population, but disorders among them in both Barca and Cyrene under Hadrian brought about a complete eclipse in favour of Apollonia in A.D. 115–16. The two cities revived under Arab rule and for some time thrived on the trade between Alexandria and Qairwan, to fall with the remainder of the province into obscurity and disorder when the Ottoman Turks came into power.

In certain respects the fate of Cyrene and its decline under the Ptolemies and its later Roman masters was a piece of good fortune for posterity. Alone among archæological sites of Greek origin of any importance in Roman North Africa, it preserves its early form virtually untouched by Roman magnificence. The state of preservation of the *temenos*, or sacred enclosure, is unique. Here two baths only were introduced by the Romans. Nothing was known of the antiquities of Cyrene until it was visited in 1861 by two English officers on leave from Malta, R. Murdock Smith and E. A. Porcher, by whom the dedicatory temple of Apollo was identified and a number of antiquities retrieved which were afterwards sent to the British Museum. The next exploration of any note was by an American expedition, and was directed to the excavation of the Acropolis. This began in 1910, but ceased when Cyrenaica was taken over by the Italians in 1912. Since then, excavations have been carried out more or less systematically by the Italians, and with some enthusiasm since 1928, when the Fascist colonial policy in Africa had assumed more highly colourful aims in the revival of the glories of the Roman Empire. The archæological finds from the excavations at Cyrene are deposited in the Museum at Benghazi, with the exception of the Aphrodite Anadyomene, which is in Rome.

The original foundation of the acropolis of Cyrene stands on the western of two hills. In the valley between them and climbing the south-western slopes of the eastern hill lies the town. The acropolis is surrounded by a wall. Outside on the north is the sanctuary of Apollo, below the sacred fountain Kyra. This spring issues through a portico from a tunnel artificially enlarged. Its course upward can be followed for three to four hundred yards, the walls being freely inscribed by visitors. The sacred precinct presents a new feature in Roman Africa, in that the underlying Greek plan can be readily followed. In it are the temples of Artemis and Apollo, each with a large altar standing before it. That before the temple of Apollo is twenty-three yards long. A remarkable feature of the temple of Artemis is a Nymphæum, which possibly may have been used for purificatory rites. In the floor of the temple of Apollo treasure cists have been found. The original temple erected by Battos I was reconstructed under Augustus, and a further reconstruction was carried out under (possibly) Hadrian, but the original plan is still to be discerned. Subsidiary temples, a Greek theatre, and Roman baths are within the *temenos* walls, which are entered by Roman propylæa. Some twenty marble statues have been brought to light on this part of the site. Among the more remarkable finds from the eastern hill is a fine head of Zeus of Pheidian type, showing a trace of gilding, to which a head of Poseidon forms a pendant.

A striking feature of the plan of the site is the Sacred Way, which lead from the sanctuary past the sacred fountain to the Agora. This latter is a colonnaded area of the conventional Roman type, with its capitol and official buildings. Here, however, are also survivals from the Greek period, the Heroon and the tomb of Battos.

To most of those, however, who have visited ancient Cyrene, the most impressive spectacle has been the vast array of tombs which line the Sacred Way along the road from Cyrene to Apollonia. They vary in size and dignity from the simple cist. with its slab cover, to the elaborate and stately façade which admits to one or more halls or chambers in which the burials lie in pits in the floor and in recesses. A few wall paintings survive, for the most part representing some form of funeral games. Participants, all in Greek dress, are both black and white in colour. Presumably, therefore, as under the constitution of Demonax in civic matters, so in ritual, Greeks and indigenes ignored the colour line.

RICKETS, CALCIUM AND CEREALS

THAT consumption of cereals may in certain circumstances lead to the appearance of rickets was first shown in 1920, when E. Mellanby[1] found that increasing the amount of them in the diet of young animals that were deficient in the antirachitic vitamin increased the intensity of rickets. Mellanby at first supposed that cereals increased the rate of growth of animals, and therefore increased the demand for the food factors necessary for the calcification of the bones and teeth. But his later experiments showed that cereals could be graded in their rachitogenic effect, oatmeal being very potent, and wholemeal wheat flour being more rachitogenic than white flour; yet the cereals with the largest amount of calcium and phosphorus, such as oatmeal and wholemeal flour, tended to cause the lowest retention of these elements in the bones and teeth. Mellanby supposed that these cereals contained an active rachitogenic substance, and this view was strengthened by his observation[2] that the effect could be destroyed by boiling the cereal with dilute hydrochloric acid. He further showed that the rachitogenic effect of cereals could be completely antagonized by adding sufficient vitamin D to the diet, and that it could be largely antagonized by adding calcium carbonate or phosphate.

In the course of her experiments on diet and the teeth, M. Mellanby[3] showed that germination of oats did not affect their anticalcifying action, but this action was greatly diminished if they were ground and allowed to stand for two days. She considered that the destruction might be due to enzyme changes or to the production of vitamin D. Templin and Steenbock[4], however, found that the disappearance of the rachitogenic action of maize, when it was germinated and autolysed, was accompanied by a change of its organic phosphorus to the inorganic form. Steenbock *et al.*[5] had previously suggested that inorganic phosphorus added to the diet might not be equivalent in physiological properties to the organic phosphorus in cereals; their experiments certainly demonstrate the fact that inequality of phosphorus intake is not the sole reason for the difference in calcifying action of the various cereals.

Steenbock's suggestion that the phosphorus compounds of cereals differ in their biological availability was followed up by Bruce and Callow[6]. Most cereals are rich in phosphorus, but 50-80 per cent is present in the form of phytin-phosphorus, phytin being the calcium-magnesium salt of phytic acid (inositolhexaphosphoric acid). Using rats on diets high in calcium and low in phosphorus and vitamin D, Bruce and Callow showed that the rachitogenic effect of cereals could be explained by the low availability of phytic acid phosphorus. This form of phosphorus was also shown to be comparatively unavailable to man (McCance and Widdowson[7]). Bruce and Callow further stated that when deficiency of calcium was the factor limiting calcification, there were grounds for believing that excess of phytic acid would interfere with the absorption of calcium; and Starkenstein[8] had shown that calcium phytate was insoluble or non-ionized. Mottram and Palmer[9] concluded that the rachitogenic action of cereals is not specific, but is due to their unbalanced calcium-phosphorus ratio. But the more extensive work of Lowe and Steenbock[10] had shown that not only the ratio of calcium to phosphorus, but also the proportion of the latter present in the phytin of cereal, determined its rachitogenic potency; they found that phytin phosphorus was partially available to the rat when the diet was low in calcium, but that the addition of calcium carbonate made it almost completely unavailable.

Mellanby, however, considered that these experiments on the relative availability of phosphorus in different compounds had little direct bearing on the positive rachitogenic action of cereals which he had described. He had found that, under his experimental conditions, the addition of inorganic phosphorus produced no improvement in calcification, and the dietary conditions in his experiments with puppies approached much more closely the conditions leading to rickets in children (which is not usually affected by adding inorganic phosphorus to the diet) than did the experiments of Bruce and Callow using rats on diets high in calcium and low in phosphorus. But their suggestion that phytic acid interfered with the absorption of calcium was directly relevant, and was followed up by Harrison and Mellanby[11]. These workers found that phytic acid and neutral sodium phytate were strongly rachitogenic when given with a non-rachitogenic diet; commercial phytin was slightly antirachitic. They concluded that "while our experiments do not support the view that the non-availability of phytic acid phosphorus has anything to do with the anticalcifying action of cereals under physiological conditions, they do strongly suggest that this anticalcifying action of cereals is due to the action of phytic acid in rendering Ca unavailable". On this view, further amounts of calcium will be used for calcification only after all the phytic acid has been precipitated, and therefore, since wholemeal flour contains more phytic acid than white, it is necessary to add more calcium to the former.

The antirachitic action of phytin was noted by E. Mellanby[12] and later by Palmer and Mottram[13]. De Bruin and Bouman[14] had concluded that the phytin content was not the cause of the rachitogenic action of cereals, and Harris and Bunker[15] had found no direct relationship between the amount of phytin phosphorus in cereals and their rachitogenic potency. These apparent anomalies were answered by Harrison and Mellanby. They suggest, for example, that in the gut commercial phytin (which is rich in calcium) might lose some calcium, which is replaced by magnesium or other bases, and this liberated calcium then might be slightly antirachitic.

The recent work of Steenbock and his colleagues[16] has shown that the whole tale of the rachitogenic action of cereals has not yet been told. Rats were given a diet containing no cereals, normal calcium and low phosphorus. Some phytic acid phosphorus was available even without vitamin D, but much more when the vitamin was given. This effect was less marked with inorganic phosphorus, and in no case was the utilization of phytic acid phosphorus equal to that of inorganic phosphorus. In other experiments[17], it was found that when calcium phytate was added to a diet containing no cereals and low in calcium, its calcium was as readily available to the rat as the calcium of calcium carbonate. Vitamin D improved the utilization of both forms of calcium to the same extent.

Recently, the same workers[18] have found that the availability of the phytic acid phosphorus was affected by the calcium-phosphorus ratio of the diet. With an optimum intake of phosphorus and a ratio of 1, phytic acid phosphorus was almost as readily utilized as the inorganic form. An increase in the ratio was accompanied by a marked decrease in the availability of phytic acid phosphorus but not of inorganic phosphorus; the ratio is of no great importance when the phosphorus is present in the inorganic form. Day[19] has shown that citrates promote calcification when given with a cereal diet containing high calcium and low phosphorus, but not when given with a purified diet; they have no effect on calcification when the calcium-phosphorus ratio is normal or low, irrespective of whether cereals are added. The cereal can be replaced by phytin with similar results.

At a recent meeting of the Physiological Society (Cambridge, December 1940), Sir Edward Mellanby gave an account of his work on the rachitogenic effect of oats, and Dr. R. A. McCance and Miss E. M. Widdowson briefly mentioned some recent results that they have obtained. Further, Steenbock and his colleagues[17] have promised to give consideration in a forthcoming paper to Mellanby's view that phytic acid acts by making calcium unavailable.

It is obvious, therefore, that a final judgment upon the rachitogenic effect of cereals must be suspended. But there can be no doubt that the addition of calcium to white flour, and particularly to wholemeal flour, overcomes the rachitogenic action of these cereals.

There is one aspect of the addition of calcium to flour that seems to have received no attention. Kletzein[20] showed that adding 1 per cent of calcium carbonate to the diet of rats diminished the iron content of their tissues (except the spleen). He further concluded: "That the retention of copper is affected by calcium supplementation in a manner similar to that of iron is suggested by other unpublished data of ours. The association of deficiencies of other minor inorganic elements such as iodine, manganese, cobalt, zinc and boron with excessive supplementation is suggested". Independently, Tompsett[21] has shown that both iron and copper are absorbed more easily on a low calcium than on a high calcium diet. From Tompsett's figures, it seems that increasing the calcium in the diet about sixteen-fold decreases the body iron about 35 per cent. A rough calculation based on the amounts contemplated by Moran and Drummond[22] suggests that the calcium intake of Orr's lowest income group may be nearly doubled by the addition of calcium to white flour. This is, of course, a very much lower increase than that used by Kletzein and Tompsett in their experiments. Certainly, this is no argument against adding calcium to the diet to combat the widespread deficiency of that element in our population; but merely correcting that fault perhaps makes it more important to combat also the deficiency of iron, which is possibly even more serious.

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A LIEBIG CENTENARY

IN the autumn of 1840, just over one hundred years ago, there was published in England and Germany Liebig's famous book on "Organic Chemistry in its Applications to Agriculture and Physiology", which was destined to exert a profound influence on agricultural science and practice. It formed part of a report which, in 1837, the author had undertaken to write on the state of organic chemistry for the Chemical Section of the British Association for the Advancement of Science, and the English edition was "edited from the manuscript of the author" by Lyon Playfair, who presumably also translated it. Part 1 of this book deals with "the chemical processes in the nutrition of vegetables", and the shorter Part 2 with "the chemical processes of fermentation, decay, and putrefaction".

In treating these subjects almost entirely from the chemical aspect, Liebig followed in the wake of Humphry Davy, whom he calls "the immortal author of the Agricultural Chemistry", for Davy had there written:

> "If land be unproductive, and a system of ameliorating it is to be attempted, the sure method of attaining the object is by determining the cause of the sterility, which must necessarily depend upon some defect in the constitution of the soil, which may be easily discovered by chemical analysis."

Liebig adopted this view, but went further; in the preface to the third edition of his book (1847), he wrote:

> "Now that the conditions which render the soil productive and capable of affording support to plants are ascertained, it cannot well be denied that from Chemistry alone further progress in Agriculture is to be expected."

There was 'nothing like leather' for these distinguished chemists, and for many decades thereafter agricultural instruction in universities was undertaken as a branch of chemistry. The exaggerated importance of chemistry to agriculture at that time is quite understandable, for the science of microbiology did not exist, the nature of plant diseases and pests was virtually unknown, and no systematic attempt had been made to apply physics to agriculture. It was also due to the lack of biological knowledge that Liebig attempted to explain the phenomena of fermentation and putrefaction in terms of pure, if rather nebulous, chemistry: "whenever the way seemed long, or his heart began to fail" he would invoke such metaphysical entities as "the vital principle", *vis inertiæ*, etc., thus attempting to explain the unknown in terms of a greater unknown. The two outstanding merits of Liebig's book were that it applied, in a manner more complete than Davy and von Thaer had done, the torch of science to the unilluminated mass of facts which empirical practice had accumulated through the ages, and it laid on solid foundations the principle and practice of restoring to the soil certain nutrient elements which had been removed by previous crops.

Liebig was the first to throw light on the nature and functions of soil humus. He did not get very far, but it is doubtful if modern chemists have got very much further. He recognized that the humus of plant physiologists and of chemists is no single chemical individual: the soil humus he defined as "woody fibre in a state of decay". He refuted the widely prevailing view that plants draw sustenance from soil humus other than the carbon dioxide disengaged in its decay, but he held that this action proceeds only in presence of growing plants, so that bare fallowing does not deprive a soil of humus; and that crop cultivation does not deplete the soil of humus, because this is regenerated by the organic substances excreted by plants through their roots. He laid much stress on these excretions or excrements, though he could adduce very little, if any, evidence of their existence.

According to Liebig, soil exhaustion is entirely a matter of depletion of mineral salts, chiefly those of the alkali and alkaline-earth metals, and fertility can be restored only by manuring, for example, with mineral fertilizers. He set the fashion in undertaking innumerable analyses of plant ashes, and he seemed to believe that practically every element found in the ash of a plant was necessary to its existence. Hence he devised a number of special manures containing a variety of mineral salts, some of which, such as potassium silicate and common salt, must have been redundant. These manures were a failure; farmers would have none of them. Though it is easy to criticize Liebig in the light of modern knowledge, one cannot help remarking on his failure to appreciate the nutrient reserves which nearly all soils contain in varying amounts, the availability of the added nutrients when incorporated in the soil, and the percentage recovery of them in the crop.

Foremost among Liebig's achievements in this direction was his recognition of the value of phosphatic and potassic manuring. He is usually, and probably correctly, regarded as the discoverer of the value of 'super' (superphosphate of lime) in the form of dissolved bones, for the preparation of which he gives a recipe in his book. It is true that Escher had already suggested the idea in 1835, and that during 1837–39 Lawes had performed many pot experiments with spent animal charcoal that had been treated with sulphuric acid (although there is apparently no written record of this work), but the idea could not have fructified without the work of Liebig. On the other hand, to Lawes must be ascribed priority in the preparation of superphosphate by treating mineral phosphates with sulphuric acid.

To the student of agriculture, Liebig is probably best known from his long-continued controversy with Lawes and Gilbert concerning how plants obtain their nitrogen. In the first edition of his book, Liebig wrote: "Cultivated plants receive the same quantity of nitrogen from atmosphere as trees, shrubs, and other wild plants; *but this is not sufficient for the purposes of agriculture*". In the fourth edition he altered the latter portion of the sentence to "*and this is quite sufficient for the purposes of agriculture*" (the italics are the writer's). Elsewhere, in both editions, he states that decaying nitrogenous organic matter contributes in a minor degree to the nitrogen supply of plants. Thus he shifted his ground; but his main contention was that atmospheric ammonia, originating in the decay of vegetable and animal substances, was the prime source of the nitrogen supply of plants. He was at some pains to explain how the ammonia (the amount of which in the air and rain water he over-estimated) became fixed in the soil, as both it and ammonium carbonate readily volatilize. He therefore postulated that minerals containing alumina, that is, clays, and iron have a great attraction for ammonia, readily combining with it and fixing it. He also asserted that humus and added charcoal act similarly. Lawes and Gilbert, in their classical experiments at Rothamsted, proved that the main source of the supply of nitrogen to plants was nitrogenous substances naturally present in, or added to, the soil. There was, of course, at that time no knowledge of nitrogen-fixing bacteria, either 'nodule' or free-living. The result of the controversy, besides settling the main point at issue, provided the scientific basis for nitrogenous manuring.

Great as were Liebig's achievements in wedding science to practice and in establishing the value of mineral manuring, it is open to question whether his chief title to fame does not rest upon his purely chemical discoveries; in any event his combustion-tube and potash-bulbs bid fair to attain immortality. One cannot agree with the dictum of A. W. Hofmann, in his Faraday Lecture to the Chemical Society in 1875, that he and Faraday were "stars of co-equal lustre", but one can stand in admiration of his intellectual ability, of his great success in establishing the first really educational laboratory at Giessen, which attracted students from many parts of the world, and of his striking personality. As a man of science, he was at times "rash in his speculations, hasty in his conclusions, and bitter in his controversies" (Odling), but in the social sphere he seems to have possessed all the virtues. Much of his success was probably due to his personality: he possessed the deep convictions and inner fire of a *Führer*, not one of the ultra-nationalistic type, but one who, at least in scientific matters, was a cosmopolitan at heart. At the same time he would doubtless have been ready to subscribe to the dictum of Pasteur, "*La science n'a pas de patrie, mais les savants en ont une*".

E. H. T.

OBITUARIES

Dr. Alfred Young, F.R.S.

ALFRED YOUNG, the fifth son of Edward Young of Birchfield, Farnworth, a prosperous Liverpool merchant of his time, was born in 1873 and died on December 19, 1940. His death is a loss not only to the parish of Birdbrook, where he was rector, and to many friends, but also to the wider scientific world in which as a pure mathematician he had won a distinguished place.

Educated at Monckton Combe School, Young gained a scholarship in mathematics at Clare College, Cambridge, which he entered in 1892. It was there that I first met him and began a friendship which continued throughout his life. As an undergraduate he took part quietly in the ordinary social and athletic life of the College. A pupil of the celebrated mathematical coach Webb, of St. John's College, he took his B.A. degree in 1895, being bracketed 10th wrangler in a year which included the names of Bromwich, Grace, Whittaker, Hopkinson and Godfrey. It was early in his third year that his interest in research began; his enthusiasm for it diverted him from the subjects laid down for the Tripos examination. His place in the lists would almost certainly have been higher if he had confined his energies to the schedules; undoubtedly, however, he chose the better path.

Young had always intended to take Holy Orders, but it was not until 1908 that he was ordained. In the meantime, he continued his mathematical research; he was the author of many papers in the scientific journals, and collaborated with Grace in "The Algebra of Invariants" published by the Cambridge University Press—the standard work on the subject. For some years he lectured at Selwyn College, but resigned that appointment shortly after his election to a fellowship at Clare in 1904. His work received recognition when in 1908 he was accepted for the degree of Sc.D. at Cambridge, in 1931 when he became honorary LL.D. of St. Andrews, and further in 1934 when he was elected a fellow of the Royal Society. This latter honour he shared with his elder brother Sydney Young, professor of mathematics at Trinity College, Dublin. Prof. H. W. Turnbull tells me that "as Young developed his method of Quantitative Substitutional Analysis he was led to the study of the Theory of Finite Groups of which Burnside and Frobenius were the leading exponents. In Group Theory Young was a worthy successor to Burnside; as an algebraist he stood in the front line, and in sheer algebraical manipulation he possessed an insight which can only be described as uncanny".

Young served after his ordination for two years as a curate of Christchurch, Blacklands, and was then presented by his College to the rectory of Birdbrook. His good work as a parish priest led to his appointment in 1923 to the rural deanery of Belchamp and to an honorary canonry at Chelmsford shortly before his death. He was an excellent preacher; a sermon of his at the Commemoration of Benefactors at Clare stood out among many such discourses to which I have listened, as admirable both in substance and in style.

Young had a quiet humour. I remember an occasion when he said to me with a grave face: "I have lost all sense of personal security". It appeared that the maidservant at his Cambridge lodgings had used some of his manuscripts to light the fire rather than waste clean paper for that purpose.

He was married in 1907 to Edith, daughter of Edward Wilson of Eccleshall, by whom he is survived. There were no children of the marriage.

G. H. A. Wilson.

Dr. G. E. Vincent

The last public appearance in London of Dr. George Edgar Vincent, president of the Rockefeller Foundation from 1917 until 1929, who died in New York on February 1, was at a luncheon given to him at the Criterion Restaurant on May 18, 1932, by the English-Speaking Union. He was a tall bronzed man of sturdy figure, expressive in countenance and eager-eyed. Talking upon the broad subject of international philanthropy in international relations, Vincent revealed himself as an amiable and persuasive character, more French than Anglo-Saxon in the rapidity and preciseness of his thoughts, as if he feared he would have not quite time enough to say all he wanted to say. It was clear to his audience that here was a man who in his day had convinced many listeners, both individual and collective.

Vincent was born in Illinois, but like many middle-westerners of the abler sort, was educated at Yale. Returning to Chicago, he taught sociology in its university. In the long vacations he joined the Chantanqua Institution, which gave lectures upon literary and scientific subjects, lectures held in tents, in many parts of the country. This varied experience with students well fitted Vincent to become Dean at Chicago (1907), then president of the neighbouring University of Minnesota (1911). His first connexion with charitable trusts was three years later; he joined the General Education Board, endowed not long before to assist American universities.

But at Minnesota, where he continued, Vincent put a strong hand to the expansion of its post-graduate schools of law, medicine, chemistry, engineering, and agriculture. Minnesota is one of the richest of American western universities, which draws large income from copper mines owned near Lake Superior, and Vincent, with such backing, found his opportunity. Meanwhile, so impressive was the counsel which he was offering to the General Education Board, that in the midst of the last war, in 1917, he was invited to the presidency of the Rockefeller Foundation.

Vincent had long been distressed over the meagreness of academic salaries. Many abler young graduates avoided teaching for more lucrative careers. He therefore strongly advocated, as soon as the War of 1914–18 ended, a distribution of £2,000,000 to endow and increase salaries of American university staff. This was the scheme under which the Rockefellers added a dollar to every dollar raised for that purpose by any well-established university or college. In the end 170 of them participated.

At this period the Foundation, under Vincent's leadership, was making large benefactions to medical education. It was particularly interested in China. Vincent, after leaving Yale, had travelled in the Orient, and his advice in respect of the support of Peiping Union Medical College was invaluable. Again, a signal gift under his regime was £500,000 for the London School of Hygiene and Tropical Medicine.

Vincent's final activities up to his retirement in 1929 included organizing for the Rockefellers the division of social sciences, in which he was a specialist, and the divisions of natural sciences and international health. WILLARD CONNELY.

Prof. B. P. Haigh, M.B.E.

BERNARD PARKER HAIGH, professor of applied mechanics in the Royal Naval College, Greenwich, who died on January 18, was born in 1884. Educated at Allan Glen's School, Glasgow, and afterwards at the University, he was apprenticed to Bruce Peeples, electrical engineers in Edinburgh, where he worked under J. L. la Cour, the inventor of the rotary converter which bears his name. This association took Haigh to Germany and to Sweden, where he obtained much valuable experience. From 1909 he was engaged for two years on the design of steering gears at the Edinburgh firm of Brown Bros., and then became assistant to Prof. Archibald Barr at the University of Glasgow. It was in 1913 that Haigh took the step which was to determine his career, when he became lecturer in applied mechanics at the Royal Naval College, where he succeeded in 1920 to the chair left vacant when Sir James Henderson retired in order to give his whole time to gunnery problems.

At Greenwich, Haigh found himself immediately confronted with a variety of new problems connected with the Royal Navy. He became a scientific adviser to the Paravane Department of the Admiralty. Of his successful work in this connexion, the solution of the problem of lengthening the life of the steel ropes which towed the paravanes in their duty of cutting the moorings of mines may be mentioned. Haigh considered that the very short life of these ropes was due to fatigue caused by resonance brought about by synchronization between the natural periods of vibration of the rope under tension and the eddies thrown off by the rope as it passed through the water. He deduced a formula and was able to increase considerably the life of the ropes. During this investigation Haigh realized, about 1917, that fatigue was greatly accelerated in steels when it takes place in the presence of a chemical reagent. He likewise established that corrosion prior to fatigue has but little effect on the fatigue limit. These were new discoveries of fundamental importance. The phenomena were rediscovered some ten years later by McAdam and are now popularly known as 'corrosion fatigue', a terminology of which Haigh strongly disapproved on account of the second fact mentioned above. These discoveries accentuated the interest which Haigh had taken, from his student days, in fatigue of metals, and on this matter he became a recognized authority both here and abroad. A large part of Haigh's published work is directly inspired by ideas connected with fatigue, although he wrote many papers on plasticity, welding, fracture and allied topics. He was also the inventor of the Haigh fatigue testing machines which are internationally used in experimental laboratories. Much of his work was of a confidential nature, and he was always busy with some Admiralty problem.

Apart from this Haigh was a very active participator in general scientific affairs. He attended the International Congresses for Applied Mechanics and was present at the recent World Power Congress in America. He was also a member of the British Association Committee on Stress Distribution in Engineering Materials and read several papers before the Association.

At the beginning of the present War, Haigh was selected as scientific adviser to the Engineering Research Laboratory of the Admiralty. At the funeral service in the Chapel of the Royal Naval College, the Chaplain of the Fleet in his encomium stated that Haigh had suggested and helped to perfect the method of overcoming the magnetic mine.

To appreciate Haigh's enormous energy it must be remembered that these activities were in addition to his teaching duties. In teaching as elsewhere Haigh was eminently successful, for he had an unrivalled gift of communicating his own enthusiasm for his subject and a quite uncommon knack of choosing happy and apt phraseology. His loss will therefore be felt by the many Naval officers who have been instructed by him, as well as by his colleagues at the Royal Naval College, who found in him loyalty and friendship.

Haigh married, in 1915, Mildred Cole. They have one son, Ian, who is now on the staff of Sir Alexander Gibb. L. M. MILNE-THOMSON.

Mr. H. W. Macrosty, O.B.E.

MR. H. W. MACROSTY, president of the Royal Statistical Society, died at his home at Woking on January 19. Mr. Macrosty had been an honorary secretary of the Society for twelve years prior to his election as president in June last. His interest in statistics was derived from his official duties in the Board of Trade, where he was prominently associated with the work on the national census of production from its inception in 1907. His work was essentially that of providing data for economists and statisticians and in providing critical comment on those data. This did not bring him into the limelight which is shed upon those who announce policies or enunciate economic propositions, but as a contribution to national service such work is in no way less important than that of those who come more prominently to public attention. Only those statisticians with practical contact with industry and trade can properly appreciate the true value of the work of those who produce statistical data.

It was the great merit of Macrosty and his co-workers at the Board of Trade that they concentrated upon accuracy and reliability in the statistical material they collected and which was the basis for the measurement of the industrial production of Great Britain. To the uninitiated a statistical table looks much the same whether drawn up from slipshod material or from data thoroughly sifted and scrutinized. The scrutiny and criticism by the Census of Production Office of the virgin material has been of the greatest importance. As a consequence, it can be truly said that although the volume of official statistical output relating to industry in Great Britain has lagged behind that of a number of others, its quality is such as to afford confidence to those who turn to the various reports for guidance and instruction, and Macrosty played a great part in establishing the confidence felt in the reliability of British official data relating to trade and industry.

To the Royal Statistical Society Macrosty gave unsparingly, both in the capacity of senior honorary secretary for many years and by practical contributions to its *Journal*, while he was the compiler of the attractive volume recording the history of the Society through a hundred years and published at the celebration of its centenary in 1934.

Mr. Eliot Howard

With the death of Eliot Howard on December 26 a distinguished ornithologist has passed away.

Howard was one of the notable amateurs for which British science, and especially perhaps British natural history, has always been distinguished. His professional work was with the firm of Stewart and Lloyd, of which he was a director for a number of years. In spite of this, he kept up his interest in field ornithology and published several important books on the subject. His most extensive work was a monograph on the British warblers (1907–1914), which embodied a great number of new observations made by himself on their habits. These observations, together with others on other types of birds, were generalized in his "Territory in Bird Life" (1920).

Though Howard was not actually the originator of the idea of territory and its importance in the life of birds, it was through his work that its importance became generally realized. He published three later studies, including "An Introduction to the Study of Bird Behaviour" (1929) and "The Nature of a Bird's World" (1935), in which his increasing preoccupation with the philosophical bearing of his observations became evident. Many of his friends perhaps regretted this preoccupation, as in their view it interfered with his publishing the vast body of original observations which he had accumulated on many species of birds. However, ornithologists will be glad to learn that his notes have been left by his widow to the Edward Grey Institute of Field Ornithology at Oxford, where they will be available for students. The Institute now possesses the field notes of all the major British field ornithologists of the last generation—Selous, Coward, Jourdain and Howard.

Howard was an outstanding example of how an amateur worker could achieve results of first-class scientific importance through patience and immense attention to accuracy and personal observation. His death is a great loss to ornithology.

Dr. W. C. Bosanquet

Dr. William Cecil Bosanquet, a distinguished London physician and classical scholar, died on January 24 at the age of seventy-four. He was educated at Eton where he was a King's scholar, at Oxford where he gained a first class in Classical Moderations and Lit.Hum. and was elected a fellow of New College, and at Charing Cross Hospital. He qualified B.M. and D.M.(Oxon.) in 1897, and seven years later was elected a fellow of the Royal College of Physicians, before which he delivered the Goulstonian Lecture in 1905, his subject being "The Nature and Treatment of Diabetes Mellitus". He was physician to Charing Cross Hospital, the Brompton Hospital for Consumption, the Victoria Hospital for Children, and the Lock Hospital. During the War of 1914–18, in which he was Captain and Major in the R.A.M.C., he served as consulting physician in the North Western Frontier Force, India. His literary activity, both as editor and author, was considerable. Besides being editor of the *Practitioner* for some years, he was assistant editor of the third edition of "Quain's Dictionary of Medicine" (1902) and editor of the eleventh (1911) to thirteenth (1923) editions of Green's "Manual of Pathology and Morbid Anatomy". In addition to numerous articles in the *Lancet* and *British Medical Journal*, he was the author of "Serums, Vaccines and Toxins" (1904), in the second and third editions of which Dr. J. W. H. Eyre was his collaborator, "The Stomach, Intestines and Pancreas" with Mr. H. S. Clogg, his surgical colleague at Charing Cross Hospital (1909), and "Spirochætes: A Review of Recent Work with Some Original Observations" (1911). In his last work, written in retirement three years before his death, entitled "Meditatio Medici: a Doctor's Philosophy of Life", he discussed the ancient and modern views of the material universe, the development of man, the physical aspects of consciousness or mind and the principles of voluntary action or conduct.

J. D. Rolleston.

We regret to announce the following deaths:

Eugen Dubois, discoverer of *Pithecanthropus erectus*, on December 16.

Prof. G. Dawes Hicks, F.B.A., emeritus professor of philosophy in University College, London, on February 16, aged seventy-eight.

Dr. A. T. Masterman, F.R.S., formerly superintendent inspector, H.M. Board of Agriculture and Fisheries, on February 10.

NEWS AND VIEWS

University of Birmingham: Annual Report

THE annual report for the session 1939–40 of the vice-chancellor of the University of Birmingham, Dr. Raymond Priestley, contains many points of interest. Two developments of major importance are the institution of family allowances for members of the staff and the introduction of compulsory physical training. Dr. Priestley, believing that the general tendency of social reform is towards the acceptance of the family rather than the individual as the normal financial unit, has long been a convinced advocate of the principle of family allowances, and he considers that universities should lead rather than follow in such matters, once they are convinced that it is right to move. He "does not fear that the introduction of family allowances will substantially delay or permanently affect the overdue improvement in the salary scales of the middle ranks of the University hierarchy where the shoe admittedly pinches most". The system is not ideal, because it cannot take account of dependants other than children, but there appears no way of overcoming this drawback without introducing unworkable complications and opening loop-holes which might be unreasonably exploited. Critics lay stress on the principle of equation of reward to quality of service, and so does Dr. Priestley, but he would measure reward in terms of standard of living rather than in money, and he would not have men penalized for having families. The allowance (confined to members of staff whose salary does not exceed £700 per annum) is at the rate of £25 per annum for every child, undergoing full-time education, up to the age of eighteen years. The allowance for the wage-earning staff is 2*s*. 6*d*. per week for each child up to the age of sixteen years if undergoing full-time education. The scheme has been in operation since February last year.

The second development is compulsory physical training for first-year students of both sexes. Two periods of ¾-hour each week are devoted to this, and the work is regarded as an integral part of the degree course, reasonably regular attendance being required. Classes of exception and individual exemptions are provided for, but the great majority of students are covered by the scheme, which is supplemented by voluntary classes in the later years. It was intended that there should be a compulsory medical examination of all students entering the University; but this is at present impossible owing to war-time demands on the local medical personnel. There is a military option in the form of membership of the Senior Training Corps. Dr. Priestley thinks this measure of compulsion is right and reasonable as a means of securing the fullest development of the student. In the conviction that the University is concerned with the development in its students of a sense of social responsibility, and of character, membership of the Guild of Undergraduates was long ago made compulsory. The universities are supposed to be training the leaders of the future. They will produce better results if they can improve the physique of the students for whom they have to cater.

Warm appreciation is expressed of the foundation by Mr. Charles Brotherton of the Charles Brotherton Trust to benefit six industrial centres, of which Birmingham is one. This University has benefited immediately by the foundation of two post-graduate scholarships (each of £150 a year) in chemistry. The terms of these scholarships include provision for the candidature of graduates of other universities. "The scholarships are therefore a valuable supplement to the still too few aids to circulation of graduates between universities, an objective that should, I believe, be kept in the forefront of any university graduate scholarship and Fellowship policy, but which is too often hampered by the local patriotism of donor and of university." The University buildings have suffered considerably from enemy action, and the damage would have been much greater but for the energetic action of the A.R.P. workers. It is surprising to learn that the extra-mural work of the University has been maintained and even extended.

Pharmaceutical Students and Military Service

WITH reference to the note on the application of the National Service (Armed Forces) Act to six new groups, covering the ages of 18–19 and 37–40, which appeared in NATURE of February 8 (p. 172), it appears that the question of the reservation of medical and dental students irrespective of the stage they may have reached in their studies has been made more comprehensive by the inclusion of students of pharmacy. It is understood that the Pharmaceutical Society is making representations to the appropriate Ministry concerning the future supply of pharmaceutical students. Such students are at present reserved from military service when they have completed two years of training, and the terms are so worded that they prevent newcomers into the pharmaceutical calling from securing reservation before they are qualified. The consequence may be that after the present generation of students has passed their examinations, there may be only women entrants to the profession for the duration of the War. It is hoped to secure a modification of the schedule which will facilitate the maintenance of a reasonable annual intake of students.

The British Museum in War-time

THE removal of the exhibits and the closure of the galleries of the British Museum (Bloomsbury) as a necessary precaution against the hazards of aerial attacks as well as a depleted staff have by no means been allowed to impose complete cessation of all activities connected with the national collections normally housed here. Indeed, even as a place of public interest and resort, the small exhibition of antiquities in the Prehistoric Room reopened in August last and the selection of books, manuscripts, prints and drawings in two ground-floor rooms have proved a considerable attraction for visitors from overseas and others. The exhibition in the Prehistoric Room includes models of prehistoric sites in Britain and a number of small archæological exhibits and photographs, an evolutionary series of European prehistoric tools and weapons of stone and bronze, a series of newly designed labels giving an outline of European prehistory or early history from 550,000 B.C. to the Norman conquest, a small case of Romano-British antiquities, and photographs and other illustrations of the Saxon ship-burial at Sutton Hoo. The exhibits are either duplicates or of little intrinsic value.

Members of the public and archæologists in particular will, however, receive with regret the announcement that one branch of the Museum's work hitherto carried on without modification or interruption will now cease, at least for the time being. The current number of the *British Museum Quarterly* (**14**, 4; 1940) contains an announcement that publication must now cease until after the War. The excellence of the illustrations and the scholarly character of the contributions, especially when they turned aside from description to broader issues raised by the exhibits, have won for this periodical an enduring place in the literature of the studies with which the Museum is concerned.

Rationalists and Current Concepts

THE RATIONALIST ANNUAL for 1941 (London: The Rationalist Press Association, 1940, pp. 86, 1*s*. net) includes, as usual, a number of articles which are calculated to stimulate controversy, even though some of them may appear to have been written with a sub-intention *pour épater le bourgeois*. Dr. Gilbert Murray in "Why Despair of Reason ?" discusses the thesis that the modern psychologists, in diminishing the authority of reason, have played an important part in turning "a decent and humane world into an ill-managed lunatic asylum"; while Sir Peter Chalmers Mitchell in "Religion in Trouble", in citing the Union of Soviet Republics as an example of the inefficacy of prayer, expresses profound admiration for the achievement of that "new force of civilization" in education and public health. From the former as a "capacity-catcher", he looks forward to "an almost colossal contribution to the progress of mankind". In a contribution on the laws of Nature, Prof. J. B. S. Haldane expounds the modern concept of their nature and authority, noting in particular such modification as has been introduced by the recent work of Jeffreys and Milne, summing up in the conclusion that "so far from being laid down by the arbitrary word of a creator, they [natural laws] may prove to be a system as intimately and rationally knit together as the propositions of geometry, and yet changing and evolving with time like the forms of plants and animals."

Of special topical interest is the article by Sir Arthur Keith on "Human Nature: a New Approach to its Study", in which he returns, but from rather a new point of view, to his now familiar argument of the part played by war in the evolutionary development of races and nations. Briefly, his argument here is that the hormones, being responsible for the differential development of racial (physical) characters, the reaction against contact and interference from outside which is characteristic of the group from the most primitive social stage onward, and is the motive force which lies at the root of the impulse to war, is a provision in human nature to preserve the integrity and isolation of the group as a breeding ground for the development of group or racial characters. Man's mental constitution, therefore, in Sir Arthur's view, thus becomes the 'breeder' responsible for race-building. Passing over the question whether he has not here allowed his metaphor from selective breeding to betray him into a false personification of man's mental constitution, it seems illogical that while he admits the continuous development in size and complexity of the social group within which inter-group discords and enmities are eliminated, he turns away from the conception of one single group embracing all mankind throughout which there would be no more war. Is it not possible to ask whether, if *Homo sapiens* is one single species, is the group struggle to perpetuate racial differences necessary to his survival ?

Carnegie Corporation of New York

THE report of the Carnegie Corporation of New York for September 30, 1940, includes the reports of the president and of the treasurer on the Main Endowment Fund and on the British Dominions and Colonies Fund. The report of the president, Mr. F. P. Keppel, points out that the Corporation has for the first time in many years incurred obligations in excess of the current income of the main endowment fund; this is due mainly to the voting of an emergency fund of 750,000 dollars for the Carnegie Institution of Washington, in addition to a grant of 150,000 dollars to make it possible for the Institution to construct a cyclotron, and to a grant of 650,000 dollars for Harvard University for the reorganization of the Dental School, but partly to the continued low interest rate. Other grants made during the year have been in the field of adult education, library interests, the arts, research and publications. Mr. Keppel points out that as yet there has been no appreciable reduction in the total supply of funds available from all sources for education and research in the United States. Steadily increasing opportunities for fundamental research are being provided by commerce and industry; funds from Federal, State and municipal sources are being maintained and probably increased.

Despite the new and compelling calls for emergency relief in the United States and abroad, a strong appeal for a good educational or social purpose has proved effective with individual donors. Mr. Keppel, however, welcomes the growing evidence of what may be termed a conservation movement in cultural philanthropy shown in the co-operative groupings of institutions which hitherto have been competitive. These groupings, which are found all over the United States, are both formal and informal, including both tax-supported and independent institutions, and they are beginning to demonstrate that steps of this character will not only save money, but also definitely improve the service rendered to students and others. The Carnegie Corporation was specifically chartered for the advancement and diffusion of knowledge and understanding. These are the broad purposes of any non-specialized American foundation. Through consultation with experts, as fair a picture as possible is obtained of each proposed inquiry, and of the human qualities of the inquirer or inquirers. The selection of those to be supported is left to the lay judgment of the Board, the decision to be made in terms not only of comparative promise but also of the funds which the Foundation itself may have available and the chances of support from other sources.

Education, the second major channel of productive activity, requires public approval and public understanding. Mr. Keppel considers that the prospect of increasing public interest in this is favourable. Much, however, remains to be done to clear the public mind as to what the public itself requires from education, and what it can reasonably expect, and also to clarify teachers' ideas as to what the processes of formal education can and can not do to affect the social order. Mr. Keppel emphasizes the importance of recognizing the enormous range in the native abilities of different individuals, as well as the failure to make the fullest use of the great body of professionally trained men and women. We must also grasp much more clearly the underlying unity of the educational process as a whole, beginning for each human being with birth and ending only with death. Division of education horizontally into its various stages, and vertically according to subject of study, has its utility, but parallels of latitude and meridians of longitude do not exist on the face of Nature. The present world situation is regarded as a further challenge to the Foundation to justify its place as a social instrument enjoying exemption from taxation and other valuable privileges.

World Affairs

RECENT Oxford Pamphlets on World Affairs (London: Oxford University Press. 3*d*. net each) well maintain the standard of the earlier numbers of the series. Mr. R. W. B. Clarke, writing on "Britain's Blockade", stresses the need for a dynamic strategy. He reviews the position of specific classes of raw materials, the crucial example of which is oil, as well as the problem of the time-factor and finally the question of food supplies, both in the enemy countries and in the occupied territories. He considers that from the summer of 1941 onwards, open weaknesses may begin to develop. Prof. H. A. R. Gibb's pamphlet on "The Arabs" describes the effect of the impact of the West upon the Arab world, from Arabia to Morocco, and the re-awakening of Arab self-consciousness and nationalism. It provides a valuable background in following the campaign in the Western desert, and indicates some of the problems which confront statesmanship when General Wavell's campaign has been successfully concluded. In Pamphlet No. 41, Mr. E. L. Woodward, under the title "The Origins of the War", seeks the deeper causes of the War. These he finds in the hostilities of certain dominant tendencies in German thought to the liberal, humanitarian philosophy and way of life of Western civilization. National Socialism, he insists, "inherited an evil tradition, and unless this tradition is understood it is impossible to realize the deeper causes making for war in Germany. We are fighting for a particular way of life, which already through the sacrifice and energy of past generations has brought us out of barbarism and set us towards a reasonable and humane existence. As long as our opponents accept their Dervish-like submission to an opposite way of life, our good is their evil and their evil our good".

Occupational Guidance

THE United States Department of Education has published a bulletin entitled "Occupational Information and Guidance: Organization and Guidance" by three experts (Washington, D.C. 25 cents). It is heavily written but important, as it begins a guidance series with a "comprehensive and basic statement of its specific functions". It gives the policy of the Office of Education with the Federal assistance which can now be claimed, the scheme as it is working at present, and types of programmes from several States. The movement is fairly new, as it began in Boston in 1909, and has penetrated far enough of late years to be called "national". The technical vocabulary employed is tedious and we select a simpler statement of the idea behind the efforts made. There are, and can be, no "misfit" children. "The child is what education is for. One might as well say that a man does not fit his clothes as to say that the child does not fit the school."

This doctrine demands a very wide appreciation of ways of making a living, and we are glad to see that this freedom is recognized. Modern conditions of competition have led to extensive changes. Retardation in education and "labor turn-over in industry" were discovered about the same time. To-day the secondary school hands over less desirable pupils to the vocational, and such schools increase, while attendance at continuation lessens. The most earnest of educators can be misled by lack of insight, or late development among young people. Napoleon left the school of Brienne for Paris carrying the recommendation that he might possibly become a fair officer of marines, but nothing more. Anthony Trollope, that best of entertainers in later life, was a dull young man. There is another danger about this vocational enthusiasm, that buying and selling and making a good living out of the process may be regarded as the one aim of living. Some years ago a publicist in Great Britain was able to tell a convention that "Business is the highest form of citizenship and advertising is the highest form of business". Does that view make for happiness, when a man is tired of his job, or for the altruism of good citizenship? A superintendent of schools in the largest American city writes of showing a pupil how to be a radio announcer, or a baseball player. What will he do when the voice is gone, or the muscles for hard hitting are relaxed? There are many new jobs to-day, but one old one remains—the use of leisure time.

Education in the United States

Education has the name of being a dull, dismal subject, though it is incessantly concerned with youth, which is in the fine phrase of Pericles the spring of the world. Its exponents are full of its jargon and have not reached the last triumph of writing, which is simplicity. American work is usually too widely documented to be bright. So we welcome as an exception to this heaviness the October numbers of *School Life*, which comes from the U.S. Office of Education (monthly except August and September, 1 dollar a year), and *School and Society*, which is run by the Society for the Advancement of Education (15 cents a copy). Both have a direct touch with the busy world scarcely possible in Great Britain, where there is less interest in vocational education; in the United States it leads to leaflets on poultry as well as on Soviet ideas of instruction. *School Life* includes a letter from the President indicating that it is a patriotic duty to continue normal education, unless required for special war work. Looking ahead, one might say that it is the business of education everywhere to prevent, if possible, the occurrence of another war. An ingenious graph arranged in ascending rows like a typewriter shows with commentary the increases and decreases in various grades of school attendance. "Radio in Schools and Colleges" recognizes that it cannot, alone and unaided, do much more than stimulate. There are no short cuts to learning, except in the optimistic promises of the world of advertisement. Teachers can learn more than pupils, but among the 360 colleges offering radio courses only one in twenty is designed for them.

There are good, long articles in *School and Society* on up-to-date ideas of the educated man, the prospects of education for war, with the mistakes of the past, on which, we note, all are not agreed, and the world the high school has to face to-day. A letter on "The Teacher's Professional Life" suggests that he should attend conventions, where he can exchange views about his 'shop'. It is important also that he should not confine himself to going about with other teachers and lose touch with the rapidly changing world which supplies his pupils and challenges him to produce good results for democracy. A plea for a better vocabulary among college seniors is interesting. But a "planned, concerted drive" may be less effective than good example, which leads to a tradition of using language carefully and well. A mark of the good speaker is his choice of adjectives.

British Electrical and Allied Industries Research Association

The twentieth annual general meeting of this Association was held on February 14, when the annual report was presented. In a foreword written by the chairman of the council, Mr. C. W. Marshall, of the Central Electricity Board, many interesting remarks about research are made. He points out that research is rarely spectacular to the layman; but owing to the steadily increasing importance to the industry of the activities of the E.R.A., it is now widely appreciated. Mr. Marshall said he has followed the development of the Association from its inception, especially in its relation to electricity supply. Three classes of investigation pursued in the Association's laboratories and elsewhere have been of special interest to him because of their vital importance to the electrical welfare of Great Britain: these are the investigations into circuit-making and breaking, surge phenomena, and properties of insulation.

The search for the most effective and economical types of circuit-breaker has been one of the most difficult and interesting investigations in the history of electrical engineering. To-day, the essential basic phenomena are well understood, at least by switchgear specialists, and circuit-breakers which are to all intents and purposes free from the formerly dreaded fire and explosion risks are available for all applications. The E.R.A. has played a leading part in this development. Lightning research has been a less urgent matter because of the comparatively small incidence of lightning faults in Great Britain. It was nevertheless appreciated that these faults had to be eliminated, and a systematic scheme of investigation was drawn up several years ago. An important stage of the work will be marked by the publication in due course of an E.R.A. compendium of information on surge phenomena, and by the introduction of a commercial model of the E.R.A. surge filter for protecting electrical equipment against damage from lightning. E.R.A. investigations into the properties of electrical insulating materials are helping to make the fundamental discoveries of atomic physicists available to the practical electrical engineer.

Rocket Flight to the Moon

Conditions of life on this earth may turn the thoughts of the escapist to contemplation of other heavenly bodies. For nearness, the moon has much to commend it. The problem of the means of transport still remains. If rocket flight be chosen, J. W. Campbell's recent paper (*Philosophical Magazine*, January 1941) will be found to give considerable help. Special attention is given to the type of flight in which the observer moves with a massive body from which rockets are fired at intervals in directions suitably controlled to guide the main body. Assuming an initial velocity more than twice that of the present muzzle velocity of artillery shells (2500 ft./sec.), a calculation is made of the *minimum* mass of the moving "rocket ship". The result is 2×10^{-9} of the earth's mass. If the mass were distributed as a homogeneous sphere of material of density about that of surface rock (3·3), then the radius of the sphere would be about 2·74 miles. Relevant factors, such as the atmospheric resistance and the control of direction, have been neglected. If they were taken into account, the initial mass would be still greater. On these calculations the rocket ship would be more than five miles in diameter, and would be as massive as Mount Everest.

Mammals and Man

WITH the view of adding definiteness to the rather vague popular ideas of the class of mammals, the Zoology Department of the National Museum of Wales has set up a temporary series of exhibits for which a descriptive pamphlet, "Mammals and Man", has been written by the keeper of the Department, Colin Matheson (pp. 22. 3*d*.). The exhibits show representatives of the main groups of mammals, and indicate some of the ways in which mammals contribute to the welfare of humanity. Thus it is pointed out that of 3,500 known species of mammals, only about twenty have been thoroughly domesticated, and some of the breeds of the most familiar animals are illustrated among the exhibits. The economic products of the group are represented by wools of various kinds, by furs, particularly dressed furs made from rabbit skins, leather, many products of bones, food materials and so on. The arrangement follows the economic zoology which was a popular diversion of last century, but we miss references to modern developments such as the varied and most important uses of whale oil, the increasing resort to mammal products in biological therapy, and the importance assumed by mammals as reservoirs of disease organisms of man or domestic stock, as in the case of cattle disease in Africa, or as the carriers and communicators of disease, as in the case of the vampire bat. This exhibition, and all such special exhibitions, will do much to keep alive general interest in museum collections, which are always in danger of becoming static and unenterprising.

Mounting Museum Specimens in Plastic

ONE of the great handicaps in making attractive to the ordinary museum visitor specimens of the smaller organisms has been the need for mounting such in formaldehyde, alcohol, or other fluid, which almost invariably bleaches colour and makes necessary awkward methods of attachment. To a considerable extent that difficulty has been overcome by the use of an acrylic resin, 'Plexiglass', the product of experiments conducted by Dr. Otto Rohm, of Philadelphia. Dr. Charles E. Sands, of the Bureau of Agricultural Chemistry and Engineering, has developed a method of embedding specimens in blocks of this material so that they resemble fossils preserved in amber, except that 'Plexiglass' is colourless and crystal-clear, clearer it is said than the finest glass, and will retain its transparency permanently. Specimens before embedding must be dehydrated in air or with alcohol or dioxan, and the setting is done in vacuum to prevent the inclusion of air-bubbles while the mountant is changing from semi-fluid to the solid state. A collection of miscellaneous specimens mounted in this way was on view at the New York World's Fair, and is permanently shown in the Franklin Institute in Philadelphia.

Fertility Rules in Fruit Planting

THE John Innes Horticultural Institution has produced a very useful leaflet (No. 4) with the above title, which sets out clearly the rules for interplanting fruit trees to ensure effective pollination. Based on many years of research to test the success of crosses between varieties of cherries, plums, pears and apples, this leaflet will be an invaluable guide to growers in the planning of new orchards and in the improvement in fertility of existing trees. It is estimated that the value of the total fruit crop of Great Britain could be increased 10–20 per cent by correct interplanting. In some existing orchards containing large blocks of trees of a single variety, much could be done to increase the crop by top-grafting a proportion of the trees with suitable pollinators. Brief reference is made in the leaflet to the causes of unfruitfulness, and exhaustive lists are provided to show which varieties are self-compatible and which varieties will ensure effective cross-pollination. Attention is directed to the reduced population of wild bees in many orchard districts and the necessity for keeping hive-bees in correctly interplanted orchards.

Feeding Value of Silage

FARMERS must be able to judge the feeding value of their silage, and to meet this need the Ministry of Agriculture has issued Bulletin No. 50 in the "Grow-more" series. High-quality silage is a cake substitute and can only be obtained from the right crop, cut at the right time and properly ensiled. The colour, smell, texture and dry-matter content of material in this category are described, and recommendations given as to the rate at which it should be fed. If any of the requisite conditions is not fulfilled, the silage can only be used to replace hay, roots, or oat straw. The value of such material varies considerably according to the type of crop from which it is made, or to the conditions during ensiling, but suggestions are given as to the rationing of several of the low-protein silages. For the less experienced farmer, a useful table is included, in which the common faults in silage, their cause and the appropriate remedy are described, and if still further information is desired, application can be made to the county agricultural organizer.

A New Pavlov Manuscript

MR. M. KRUTIKOV, who is working at the archives of the Academy of Sciences of the U.S.S.R., has discovered the manuscript of a hitherto unknown work by the Russian physiologist, the late Prof. I. P. Pavlov. The work, which had been submitted for a competition for a prize of the Academy, is entitled "The Centrifugal Nerves of the Heart", and it is dated 1885; it consists of 19 pages. It seems that when the manuscript reached the Academy it was handed for report to I. Tarkhanov, who, after some time, presented a long scientific review of the work. However, he failed to come to any definite conclusions about it, because of the absolute newness of the subject and the absence of any literature on it. It is hoped to include the new paper in the complete edition of Pavlov's works which the Academy proposes publishing.

The Linnean Society of London

General meetings of the Linnean Society of London are to be resumed at 3 p.m. on the following Thursdays: March 6, April 3, and May 1. On March 6, several papers will be read. The centenary of the Royal Botanic Gardens, Kew, as a Government institution occurs on April 1, and at the meeting on April 3, Sir Arthur W. Hill, director of the Royal Gardens, will give some account of the work of Kew during the past hundred years. At the meeting on May 1, the Society will keep the tercentenary of the birth of Nehemiah Grew, when Dr. Agnes Arber will give an account of him, and of Marcellus Malpighi. The anniversary meeting will be held on May 24, when the president will address the Society. The council is to consider the possibility of prolonging the session into June and July.

Announcements

Owing to the generosity of the Rockefeller Foundation, which has provided a grant for the purpose, the Royal Society is in a position to give some assistance to scientific societies and associations which, as a result of war conditions, are experiencing financial difficulties in the publication of scientific journals.

Among the bequests in the will of the late Sir Robert Hadfield, who died on September 30 last, are the following: gold and other medals, diplomas and certificates to the University of Sheffield for any library or museum in connexion with the Faculty of Metallurgy, and failing acceptance, to the Science Museum, South Kensington; his collection of alloy specimens forming the record of his various papers to scientific and technical societies to the Science Museum, South Kensington; £1,000 to the Imperial Cancer Research Fund; £1,000 to the Royal Society for general research work.

Dr. J. Burtt Davy, late University demonstrator in forestry in the University of Oxford, who died on August 20, bequeathed a bond for £7,000, secured on property in the Transvaal, or any of the capital paid, to the Chancellor, masters, and scholars of the University of Oxford, to found a scholarship, "The Burtt-Davy Research Scholarship", for research work in taxonomic botany and/or tropical plant ecology.

The University of Liverpool is to receive a sum of £2,500, under the will of Mrs. Mary Harmood Hamilton, to endow a scholarship or scholarships in the Faculty of Engineering.

Sir Andrew Davidson, county medical officer for the North Riding of Yorkshire, has been appointed to succeed Prof. J. Mackintosh as chief medical officer of the Scottish Department of Health.

Mr. Hector Leak has been appointed president of the Royal Statistical Society, to hold office until the next annual general meeting, in succession to the late Mr. Henry W. Macrosty (see p. 230 of this issue).

Mr. George Grant, registrar of University College, Southampton, since 1923, has been appointed registrar of the University of Birmingham to succeed the late Mr. D. J. Cameron. The status and stipend of registrar have been raised to equality with those of full-time professors.

The journal *Microentomology*, issued from the Natural History Museum of Stanford University (California), is now in its fifth volume. Among recent issues that have come to hand are contributions by Dr. G. F. Ferris and others on the detailed external morphology of selected types of the various orders of insects. These accounts are very clearly illustrated by well-executed figures that are intended to meet deficiencies in this respect in many existing publications. The journal, it may be added, is obtainable from the Director of the Museum, and individual parts are obtainable separately at a low price.

During the committee stage in the House of Commons of the War Damage Bill, Sir William Jowitt said, in reply to an amendment put forward by Mr. K. W. M. Pickthorn, one of the representatives of the University of Cambridge, that universities must be regarded, for the purpose of the Bill, as carrying on business. That being so, they would not be exempt from compulsory insurance, but he added that the Government would use its powers under the clause to exempt from the obligation to insure certain classes of the non-essential equipment of universities. He expressed the hope that the Government would receive assistance from the universities and their representatives in formulating a workable scheme.

A catalogue of books relating to Egypt recently issued by Mr. George Salby, oriental bookseller, of 65 Great Russell Street, London, W.C.1, has a special association interest for Egyptologists and students of the archæology of the Middle East. It includes the libraries of two well-known archæologists. First that of J. L. Starkey, excavator of Lachish, whose assassination by an Arab brought to a premature close one of the most illuminating of recent archæological excavations in Palestine; and secondly, that of Alan W. Shorter, assistant keeper of the Department of Egyptian and Assyrian Antiquities in the British Museum, whose early death cut short a career of much promise. In addition to books which might be termed the tools of a working archæologist, the catalogue includes a number of rarities, among them Prisse d'Avennes "L'Art Arabe", text with three volumes of 200 plates, Rosellini's "Monuments of Egypt and Nubia", and Arthur Upham Pope and Phyllis Ackerman's "A Survey of Persian Art from Prehistoric Times to the Present", the last-named a monumental and scholarly production.

Erratum. In the letter "Rheology of Plastic Materials" in Nature of February 8, p. 176, for the formula "$\psi = S\sigma^{4}t^{k}$" read "$\psi = S\sigma^{-1}t^{k}$".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Legal Protection of the Names of Animal Breeds

VERY often the name of a breed of animal, after being imported into another country, is changed there. This new name given by the importers leads to the impression that the breed is a new one and of native origin, for which the importer unfairly claims the credit, whilst it is really a foreign race. One must consider that this manner of appropriating the work of another is a fraud, and should be treated as such, just as literary plagiarists are punishable by law. Neither can the products of grading be regarded as a new race. It would be better to name the first generations of grades according to their different amounts of blood with regard to the polygenic characters, just as horse grades, for example, are called: $\frac{1}{2}$-, $\frac{3}{4}$-, $\frac{7}{8}$-, $\frac{15}{16}$-blood. As regards the following generations, closely resembling the pure breed of livestock, they should be given the name of the race used for grading, together with the name of the region where the rearing took place, as in the imaginary example: Southdown of Holstein. This name would describe a race of sheep bred in Holstein, being the result of grading native sheep with pure-bred Southdowns.

For the countries which export breeding stock it is of great economic importance to have the names of animal races protected legally. There are many cases known in which animals were imported to another country, multiplied and then advertised as new breeds and sold to another country again. Or in other cases crossbreds produced in some countries by crossing British or Swiss breeds with native stock were sold as pure-bred British or Swiss or under a changed name, as a new breed. These products, being crossbred, had no real breeding value.

This problem has a domestic importance in every country, and not only in connexion with the export of breeding stock. Some people lay claim to be creators of new breeds, simply by making single or double crosses of different existing breeds.

From the scientific point of view, it is also very important to know the origin of every breed, and the crosses used to develop a new type or breed. The use of genetical methods to improve animal breeding would be much easier if the origin of many breeds were not obscured, as is often done purposely.

In order to direct attention to this problem, which is so important to breeders and to the science of breeding, I read a paper at the Fourth International Congress on Animal Breeding in Zurich in July 1939, under the title "The Protection of the Denomination of Animal Races by Law". Afterwards I proposed to the Congress that it should pass a resolution to protect legally the names of animal races, a protection which would be of great value and importance not only from scientific, but also from economic and moral points of view. After a very lively discussion, the resolution was passed to put the matter in the hands of the "International Association for Animal Production" to be constituted. (See Proceedings of the Congress, Zurich, 1939, pp. 333 and 403.)

The subsequent breakdown in international relationships has arrested this promising start. It is in any case very desirable that a *controlling body should be established* in every country engaged in producing and exporting the breeding stock. The same body, it is proposed, should also have the power to decide when a new breed has been developed. The question of whether or not a group of animals could be called a new breed needs careful and individual consideration; every case should be judged on its merits.

The interests of Great Britain in this matter being so considerable, it seems especially needful to establish such a regulatory organization in this country, possibly with others in the Dominions. If other countries do establish similar controlling bodies, the question of linking them up and integrating them could usefully be gone into after the War as a preliminary to the resumption of international trade in breeding livestock. It would be fitting for Great Britain to take the lead.

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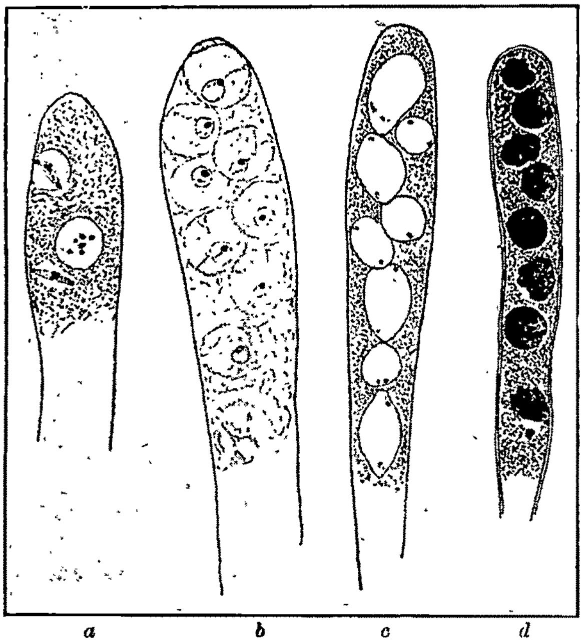
Jan. 25.

Ascospore Dimorphism of *Bulgaria inquinans*, Fr.

THE adult ascus of *Bulgaria inquinans* typically contains eight spores, four of which are large, dark and thick-walled, the rest being small, thin-walled and hyaline.

According to Moreau[1], the explanation of this dimorphism is to be found in the earlier development of the ascospores. He alleged that the three successive divisions of the definitive nucleus of the ascus were not synchronous, and this resulted in a precocious development of four of the ascospore nuclei. Then, during the subsequent differentiation, these nuclei became invested with a greater quantity of spore-plasm than the remainder, the final result being a spore dimorphism.

During an investigation of the cytology of this fungus, in the course of which two reduction divisions were observed in the earlier development of the ascus, a number of observations upon the development of



the ascospores was also made. None of these was in agreement with those of Moreau. No asynchronism of the mitoses in the ascus was observed, the number of nuclei present was always one, two, four or eight, indicating that the divisions were quite regular. The phases of the divisions were nearly always synchronous also, as is seen, for example, in the metaphases of the last meiosis, three of which are shown in the accompanying figure (*a*).

The mode of spore delimitation involving the participation of a nuclear beak and astral rays was quite normal, and at the time of the formation of the spore membranes the ascus contained eight isomorphic uninucleate spores. At this time also the ascospores passed from an ellipsoid to a spherical form (*b*). It is subsequent to this condition that the dimorphism begins. Four of the spores increase in volume and become ellipsoidal again, the others undergoing very little further increase. After the dimorphism has been established and the spores are assuming their final form, the nucleus of both types divides so that each is at least binucleate in the mature condition (*c*). The dimorphism here is thus dissimilar from that found occasionally in *Neurospora tetrasperma* (Colson[2]) and some other fungi, where the large spores are binucleate and the small uninucleate, since in the former the initial condition for all the spores is a uninucleate one, whereas in the latter the larger spores are initially binucleate.

An examination of asci in which the fatty material of the spores had been blackened by the osmic acid in the fixative showed that in young asci where there was as yet no external dimorphism, the arrangement of the osmicated droplets fell into two classes (*d*). They appeared in four young spores as flocculated and in the other four as consolidated masses, and an examination of even earlier stages showed that the latter was a condition derived from the former. The four spores containing the condensed fatty material increased in size and finally developed the thick brown walls characteristic of the large type. At the same time the osmicated substance increased in amount, finally breaking up into a small number of large droplets. No alteration from the original condition was observed in the small spores.

On account of the correlation between the above changes and the development of the dimorphism and the inability to support Moreau's conclusions, it is suggested that the cause of the condition is to be sought in a difference in the fat metabolism of the two spore types. In other words, the explanation is physiological rather than cytological.

A full account of this investigation will be published elsewhere.

C. L. Foster.

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Leeds.
Jan. 17.

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[1] Moreau, F., *Bull. Soc. Mycol. France*, **30** (1914).
[2] Colson, B., *Ann. Bot.*, **48** (1934).

Inhibition of Nitrification by Chromates

The occasional presence of chromates in sewages which receive discharges of trade effluents from the chromium-plating industry led us to investigate the influence of chromate on sewage purification processes. Samples of sewage containing sufficient potassium chromate to provide 1, 10 and 100 mgm. chromium per litre of sewage were treated in laboratory percolating filters, and comparisons were made with a control filter. The results, already published[1], showed the oxidation of organic matter proceeded satisfactorily with up to 10 mgm. chromium per litre, but that nitrification of ammonium compounds did not occur to the same extent as in the control filter.

In continuation of these experiments, the effect of chromates on the purification of sewage by activated sludge is now being studied. The activated sludge was built up by aerating domestic sewage until a sludge was produced capable of completely oxidizing 40–50 mgm. ammoniacal nitrogen per litre to nitrate within 12 hours at 18–19° C. When aerated with sewage containing potassium chromate equivalent to 10 mgm. chromium per litre, part of the activated sludge failed to produce nitrate within 24 hours, but instead nitrite was formed. Within 48 hours, following a second addition of sewage containing 10 mgm. chromium per litre, formation of nitrite and nitrate ceased: aeration with fresh additions of sewage without chromate failed to cause oxidation of ammonium compounds within a period of eight days. Other experiments with the nitrifying sludge showed that three charges of sewage containing 5 mgm. chromium per litre added on successive days was enough to arrest nitrification. The same phenomenon as before was observed, namely, that the sludge after contact with chromate did not recover its power of nitrification after aeration with sewage for one week.

The study of further aspects of this subject is now in progress, but it seems worth emphasizing that not only is the activity of organisms concerned with the production of nitrite and nitrate from ammonia arrested in presence of small concentrations of chromate, but also that the inhibitory action appears to last for a considerable period after removal of this inhibiting agent. Although nitrified effluents are not obtained by aeration with activated sludge in presence of chromate, it is still possible to obtain effluents which in every other respect are well oxidized and of high purity.

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C. H. HEWITT.

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[1] Jenkins and Hewitt, *J. Soc. Chem. Ind.*, 59, 41 (1940).

Origin and Nature of Heavy Ionization Particles Detected on Photographic Plates Exposed to Cosmic Rays

IN a previous communication[1] we gave an account of star-like tracks obtained in vertically placed Ilford Halftone plates exposed to cosmic rays at Sandakphu (3660 m.) and Darjeeling (2130 m.). We suggested that they were due to secondary mesotrons. Since then we have carried out a more detailed examination of these plates and also of other similar plates kept at Sandakphu for 202 days (i) under 20 cm. of water in a galvanized iron box, (ii) in a lead box with 5·5 cm. lead on the top of the vertically placed plates. The last-named plates on development were found to be fogged. Fortunately, the observations of Heitler and his co-workers[2] on similar plates exposed under different thicknesses of lead at Jungfraujoch supplement our observations and are in agreement with our results.

(I) In the course of our examination of the exposed photographic plates during the last year and a half, we observed a number of curved tracks on them. Our experience with proton tracks produced on similar plates led us to the view that the former could not be due to protons but were probably due to mesotrons. To test this point we exposed a Halftone plate to fast neutrons due to a radium-beryllium source, with 10 cm. of lead to cut off the gamma rays. Fast protons are produced in the material of the film due to collision of the fast neutrons with hydrogen atoms in the latter, and proton tracks up to 40 cm. air range were observed. The total range in air, the mean particle distance and the total angle of scattering of the cosmic ray and proton tracks are given in Table 1.

TABLE I

Track No.	Total air length	m.p.d.	No. of curved tracks	Sum of scattered angle
A. Sandakphu (air)				
1–22	380 cm.	5·5 μ	4	19°
23–45	356	4·2	9	57°
46–77	395	3·4	12	61°
78–87	107	2·7	2	12°
B. Proton tracks				
1–74	1111 cm.	2·6	2 single scattered 1 curved	

According to the theory of nuclear multiple scattering of charged particles, the mean deflection $\bar{\theta} = \frac{Z z e^2}{W} (Nt)^{1/2}$ (3·69+a log. correction term), where Z and z are the atomic numbers of the scattering and scattered particles, W the kinetic energy of the latter; that is, the scattering varies as $1/v^2$ of the particles. On the other hand, it is found empirically, and this result finds reasonable interpretations in the theory given by Helens and Wilkins[4], that the mean particle distance along the ionization tracks in photographic emulsion increases with the velocity of the particle, that is, the faster particle will be characterized by greater m.p.d. and smaller scattering. Judged according to this criterion the cosmic ray particles and the protons cannot be of the same kind, and assuming that they both carry the same charge, the former has a smaller mass than a proton. In view of the fact that we and also other investigators have failed to observe discrete tracks on photographic emulsions due to fast electrons, it can be reasonably concluded that the tracks recorded in Table 1 *A* are due to mesotrons.

(II) Absorption in water and air: In Table 2 is given the number of tracks observed in photographic plates kept at Sandakphu and Darjeeling under different conditions. To obtain a measure of the energy of the cosmic radiation, we have counted the number of tracks per cm.^{2} on the plates, excluding those tracks in which the mean particle distance is less than 2·2μ, as experience shows that such tracks are due to α-particle contamination.

TABLE II

Sandakphu	Plates kept under	No. of tracks per cm.^{2}/100 days	No. of tracks absorbed due to	Ratio of absorption
	(i) air	165	20 gm./cm.^{2} water	
	(ii) 20 cm. water	67	98	1·6
Darjeeling	(iii) air	103	140 gm./cm.^{2} air 61	

The conclusion can be drawn that the component of the cosmic ray responsible for producing heavy ionization tracks in photographic plates is more strongly absorbed in water than in air and that it is probably neutrons. The relative energy loss due only to elastic collision in the given masses of water and air of the high-energy neutrons responsible for multiple shower production, can be calculated from the following consideration. A neutron during such a collision with an atom of mass M loses on an average $2/M$ of its energy; that is, it requires $M/2$ collisions to produce the same loss of energy as collision with a hydrogen atom. We can then calculate the number of equivalent hydrogen collisions in the two media, and their ratio comes out 1·7, which is very near the observed value of 1·6.

The agreement between the two (if not accidental) can be made plausible on the following assumptions: (i) such high-energy neutrons are very seldom produced in the mass of air between Sandakphu and Darjeeling; (ii) the cross-section for elastic collision is large compared with that for shower production; and (iii) on an average they do not suffer more than one hydrogen-like collision.

According to the older perturbation theories of Bhabha and Heitler, the scattering cross-section of fast mesotrons by protons increases with the mesotron energy and is independent of the proton mass. The first of these conclusions and the order of magnitude of the scattering cross-section is not in agreement with experimental results. According to the revised theories proposed by the same authors[5,6], the calculated scattering cross-section is in agrement with the observed results, but the production of multiple mesotron showers is not possible according to it, while the older theory could account for it. Our results are thus not in agreement with the predictions of the newer theories. A recent theory of Heisenberg[7] appears to give a reasonable picture of multiple shower production by the impact of fast neutral particles on neutrons and protons; according to this view, the scattering cross-section of mesotrons diminishes with the increase of proton mass and has a much smaller value for high energies than that given by the older theory.

(III) We do not feel competent to judge the validity of the assumptions underlying the different theories; we have, however, tried to verify one consequence of the new theory proposed by Bhabha, according to which the following reaction is possible: $p+p \rightarrow p_2+n$. the minimum energy required is 35 Mev. and the cross-section for such a process is $3 \cdot 2 \times 10^{-26}$ cm.^{2}, which is expected to occur when a fast proton traverses about 45 cm. of water. We have examined the plate kept under 20 cm. water for 202 days for tracks of such double-charged protons. The latter will ionize like α-particles, and in order to distinguish them from the latter we have looked for such dense tracks of length greater than 10 cm. of air. In an area of $1 \cdot 05$ cm.^{2}, no such track was observed. The negative result may be due to the small number of high-energy protons present in the cosmic ray.

We are indebted to Dr. R. C. Mazumdar for directing our attention to Bhabha's paper.

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Biva Chowdhry.

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Nov. 12.

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[1] Bose and Chowdhry, Nature, **145**, 894 (1940).

[2] Heitler *et al.*, Nature, **144**, 283 (1939); **146**, 65 (1940).

[3] Williams, *Proc. Roy. Soc.*, A, **169** 531 (1939).

[4] Helens and Wilkins, *Phys. Rev.*, **54**, 783 (1939).

[5] Bhabha, *Proc. Ind. Acad. Sci.*, A, **11**, 346 (1940).

[6] Heitler and Ma, *Abst. Proc. Roy. Soc.*, July 18, 1940.

[7] Heisenberg, *Z. Phys.*, **113**, 61 (1939).

Effective Frequencies of Sensitive Flames

Brown[1] showed in 1932 that if a graph of flame-height against frequency of the sound were plotted, there occurred a large number of maxima and minima, and that the frequencies of these maxima and minima were independent of the gas velocity, the shape and size of the jet, and the amplitude of the sound; and further, that those for hydrogen were indistinguishable from those for coal-gas. From his theory of edge-tones he has recently concluded that the reaction of the external air (the only constant factor) cannot be neglected[2]. In order to exclude the effects of resonance of all kinds, Brown repeated his experiments with entirely different apparatus in a different laboratory, but the frequencies remained unaltered.

Some recent observations of mine support Brown's results. They were made in the Department of Applied Physics in the University of Basle in Prof. Zickendraht's laboratory. The apparatus consisted of a Siemens-Halske oscillator, an amplifier and a 'Blue Spot' loud-speaker. Differently shaped brass jets were used, and the response to the sound was observed by measuring the change in the height of the coal-gas flame. The change in output of the oscillator-amplifier set was checked by a galvanometer placed in series with the moving coil of the loud-speaker, and care was taken to ensure that any maxima and minima of the output were eliminated by a sliding resistance.

It was found that the occurrence of the main maxima and minima of response depended only upon the frequency. The main minima were at frequencies of 1,200, 1,490 and 2,140, and the main maxima at 1,180, 1,470, 1,680 and 2,960. Comparison with Brown's detailed results shows good agreement. No marked maxima or minima occurred at higher frequencies with the jets used.

It seems, therefore, that, difficult as these results are to explain theoretically, they cannot be attributed to resonance either in the laboratory or in the apparatus.

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at the University College of North Wales,
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[1] Brown, G. B., *Phil. Mag.*, **13**, 161 (1932).

[2] Brown, G. B., *Proc. Phys. Soc.*, **49**, 519 (1937).

Glaisher's Table of Powers

Is there any contemporary of Dr. J. W. L. Glaisher who can throw light even now on the mystery of his suppression of completed tables? The basis of the Table of Powers just published by the British Association [see p. 219 of this issue of Nature] is a table of the first twelve powers of the first thousand integers compiled by Glaisher. This table was finished in 1873 and was stereotyped, but it was not published. The plates were presumably destroyed, and the proofs seem to have been systematically hunted down. One copy survived in secret; Mr. H. J. Woodall found it among papers left by Lieut.-Colonel A. J. C. Cunningham, recognized its value, and presented it in 1935 to the British Association Tables Committee.

A similar story is attached to the Number-Divisor Tables prepared last year by the same Committee. Glaisher completed a set of tables for the Cambridge Philosophical Society in 1884, type was set up, plates made, and proofs pulled, and there the matter rested until ten years after Glaisher's death.

Also among Glaisher's papers were found volumes of manuscript tables of four theta functions, the denominator and the three numerators of the Jacobian elliptic functions, computed at degree intervals of the modular angle. This is an enormous piece of work, and apparently Glaisher was content that nobody should benefit from it. Why?

It is easy to account for the abandoning of an unfinished enterprise. The only obvious reason for the suppression of a finished table is the discovery of a systematic error, and Glaisher had not this reason. The British Association Committee submits all its material to the most drastic checks, and Glaisher's work was almost perfect: a missing digit in one table, a few accidental errors that his own process of checking would have detected in another, is the whole tale of faults.

In the preface to the Number-Divisor Tables, I wrote: "It is as if Glaisher knew too well the distance that separates accurate manuscript from faultless print, and could not force himself to the irrevocable step of authorizing publication". But this is sheer conjecture. Can no mathematical confidant, no reluctant printer, speak from knowledge?

E. H. Neville.

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Reading.

Sir J. J. Thomson, O.M.

I am collecting material for a life of the late Sir J. J. Thomson, master of Trinity College, Cambridge. If any readers of Nature have letters from him containing matter of interest, I should be very grateful for the loan of them. They would be copied and returned as soon as possible.

Rayleigh.

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Chelmsford, Essex.

ORIGIN OF METEORITES

IN the Halley Lecture* of 1940, Prof. F. A. Paneth presents a most stimulating and informative survey of the many hypotheses that have been proposed in the attempt to solve the difficult but fascinating problem of the origin of meteorites, with special reference to the evidence on which modern views are based.

In addition to the accepted groups of 'irons' and 'stones', Paneth follows Suess in claiming 'glasses' (tektites, etc.) as meteorites—despite the fact that no actual fall of tektites has been reliably observed—on the ground that, since hypotheses explaining the occurrence of tektites as products of human manufacture or as terrestrial formations can easily be disproved, there is no alternative but to assume that they are of celestial origin. Moreover, the hypothesis of Michel, adopted by Lacroix, that tektites are formed in the atmosphere by the oxidation of silicon and other elements, is disproved by the fact that the rapid flight through the atmosphere of these alleged elements would allow far too little time for reaction with the enormous volume of oxygen that would be required. Paneth throws out the suggestion that silica-rich granitic bodies representing the original material of the tektites may have entered the Roche limit of the sun and there suffered melting and dispersal, to form swarms of glass globules on cooling after leaving the perihelion neighbourhood. It has, of course, to be recognized that our interpretations of the origin of iron and stone meteorites may not apply to the glasses. In this connexion it is relevant that while there are transitional varieties between the first two classes, there is none whatever between either of them and the third. In what follows, therefore, reference is made only to iron and stone meteorites.

Evidence consistent with the origin of meteorites in the solar system is: (*a*) The close geochemical analogy between meteorites and terrestrial materials, even to the minor chemical elements and their distributions. (*b*) The identity in isotopic constitution of all the meteoritic elements so far tested with those of the corresponding terrestrial elements; this applies even to the radioactive elements uranium and potassium, and since the isotopic ratios of a radio-element vary with time, such identity points to the simultaneous origin of both meteoritic and terrestrial uranium and potassium. (*c*) Paneth's own determinations of the ages of iron meteorites, none of which is of a higher order than that now assigned to the earth: here it must be noticed, however, that with the coming into favour of the 'short' time-scale of the universe this item of evidence can no longer be claimed as an argument against an extra-solar origin for iron meteorites.

The chief astronomical arguments bearing on the birth-place of meteorites depend upon observations (*a*) of the orbits and velocities of falling meteorites; and (*b*) of the distribution of meteorite falls during the hours of the day. In a few cases heliocentric velocities have been recorded which are sufficiently high to imply an interstellar source for the meteorites concerned. Hoffmeister has, indeed, declared that the interstellar origin of a majority of meteorites is a "well established fact", and the preliminary results of Opik's researches at Arizona seem to support this claim. The evidence, however, is conflicting, and the validity of deductions from purely visual observations has been seriously questioned. Paneth refers to recent photographic studies by F. L. Whipple on nine sporadic meteors, which proved that at least eight, and perhaps all, were moving in elliptical orbits; he also cites the opinion of Fletcher Watson and C. C. Wylie that visual observations are inevitably subject to a systematic subjective error which always leads to the over-estimating of velocities. Clearly the interstellar hypothesis cannot be regarded as 'well established' and it is still more gravely weakened by the other line of astronomical evidence, which supports the alternative view that meteorites originated in the solar system. It is found that a majority of the meteorites seen to fall strike the earth between noon and midnight, and from this preponderance it can be inferred that most, and possibly all, meteorites move in 'direct' orbits. Niessl has argued against the validity of this inference, but Lindemann has in turn convincingly disposed of Niessl's objection. Summing up the whole position, Paneth thinks we may safely assume that meteorites have been members of the solar system since their formation.

Other points of interest discussed in the lecture refer to the conditions under which meteorites may have been formed and to their subsequent history. Recent attempts to reproduce the Widmanstätten structure show that it is not formed during solidification from a molten mass; but is due to a later re-orientation of the iron and nickel atoms which occurs while the crystals very slowly cool. The perfection of this structure in iron meteorites implies extremely slow cooling at a relatively high temperature. The parent mass or masses must therefore have had very considerable dimensions, an inference which is consistent with the common view that meteorites may be fragments of asteroids (or of a single asteroid) which came, perhaps several times, within the Roche limit of, say, Jupiter. C. C. Wylie has found that the Pultusk meteorites moved in elliptical orbits resembling those of the small asteroids in their eccentricities, inclinations to the ecliptic, periods of revolution, and mean distances from the sun. The widely varied 'ages' of iron meteorites further suggest that some of the asteroids or their fragments may have passed near enough to the sun to have had their earlier store of helium driven off.

The long and "rather wild" history of stone meteorites which can be read from their intricate structures also points to periodic heating and cooling, and this again suggests close approach, several times repeated, to the sun. Paneth does not overlook the tantalizing complications that this possibility introduces with regard to the development of the Widmanstätten structure. These and other points of detail—such as the origin of chondrules—continue to remain obscure.

Nevertheless, while admitting that the complete story still remains to be told, it is clear that the leading features of the origin of meteorites are now well within our grasp. Prof. Paneth is to be congratulated on a masterly review of a subject to which he himself has made notable and far-reaching contributions.

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* The Origin of Meteorites. By Prof. F. A. Paneth. Pp. 26 + 3 plates. (Oxford: Clarendon Press, 1940.) 2*s*. 6*d*. net.

THE POPE COLLECTION OF ALCHEMICAL PAINTINGS AND ENGRAVINGS

By Prof. John Read, F.R.S.

THE late Sir William Jackson Pope, professor of chemistry in the University of Cambridge from 1908 until 1939, besides being one of the most eminent of British chemists, was known among the *cognoscenti* as a discerning collector of alchemical paintings and engravings. His treasures included many fine examples, either originals or engravings, of the work of the younger Teniers, Wijck, Bega, Steen, and other painters of the celebrated Dutch school of the seventeenth century. Among other items of much interest there was an unusually complete series of the rich reproductions in mezzo-tint of the paintings of Joseph Wright, the eighteenth-century painter of Derby, whose strangely effective high-lights are seen to such advantage in his representation of the discovery of phosphorus and in his charming study of a philosopher giving a lecture on the orrery.

There was also an impression of the rare engraving on copper, dated 1643, showing the experimenting Franciscan monk, Bertold Schwartz ("Black Bertold"), of Freiburg im Breisgau, "Doctor, Alchimist, und Erfinder der freijen Kunst des Büchsenschiessens, im Jar 1380", firing a charge of gunpowder with a flint and steel in his laboratory. Very exceptionally, the collection contained engravings in both 'enantiomorphous forms' of Teniers' "Le Plaisir des Fous": this famous picture, caricaturing the unintelligent operations of the 'puffers', or exoteric alchemists, depicts an ape seated at an alchemist's hearth with a pair of bellows, the operative paw being the right in one reproduction and the left in its 'mirror-image'. The pair of small engravings, which used to face each other upon the mantelpiece of Pope's study in Cambridge, naturally made a strong appeal to the great master of stereochemistry, who had taken delight for so long in the production of new and startling dextro- and lævo-forms in the laboratory.

One of the most attractive items in the collection was an original oil-painting, "The Chemyst", by Cornelis Pietersz Bega. This used to grace the entrance hall of the owner's Cambridge home, and it came from the Sawbridge-Earle-Drax Collection. Painted on a wooden panel, it is remarkable for the purity of its flesh-tones, its striking light effects, and its delicate tones of heliotrope and blue. An excellent black-and-white reproduction of this picturesque alchemical interior by Bega adorns the cover of a recent issue of *The Laboratory*, an interesting advertising periodical published in booklet form by the Fisher Scientific Company of Pittsburg, Pennsylvania.

Some time after the death, in October 1939, of Sir William Pope, his collection was acquired by the Fisher Scientific Company; having survived the perils of an adventurous passage across the Atlantic, it is now safely deposited at Pittsburg in the well-known Fisher Collection of notable pictures dealing with alchemy and historical chemistry. The Fisher Scientific Company has combined enterprise with good fortune in securing this handsome accession, and the pleasing thought is worthy of expression that the Pope Collection will preserve its identity in the new milieu.

It is a sign of the great interest taken by American chemists, both academic and industrial, in the historical evolution of their science that an American industrial corporation should take such pains in building up a purely historical collection of the kind under notice. While congratulating the United States most cordially on her clear vision and good fortune in this matter, all British chemists who appreciate the interest, inspiration and educative value of historical chemistry will entertain a feeling of regret that a collection of such outstanding merit as that of Pope could not have been preserved in Cambridge.

These beautiful alchemical paintings and engravings, together with the fascinating collections of drug jars and ornamented mortars brought together by the same hand, would have formed an artistic and unique addition to the Fitzwilliam Museum, besides providing a memorial truly characteristic of Sir William Pope, who accomplished more for the Cambridge school of chemistry than any other man.

EXCAVATIONS AT ELMSWELL, EAST YORKSHIRE, 1938

EXCAVATIONS on the Roman site at Elmswell, carried on by A. L. Congreve in 1936–37, were continued by Philip Corder in 1938 (*Hull Mus. Pub.*, No. 207; 1940). In the earlier investigations finds were both plentiful and remarkable, including thirty-seven coins ranging from one of the Iceni, coins of the whole Roman period and a barbarous type resembling a *sceatta*, pottery unstratified, but of the whole Roman period in the north, ending with an extensive collection of late fourth century ware, the earliest decorated Samian being of the period of Domitian, and stamped Saxon sherds; and a large pile of iron slag, estimated at half a ton in weight, "the product of direct reduction of fairly pure iron ore", which is similar chemically and petrographically to other Romano-British slag. The varied nature of the finds indicated a long period of occupation, which from other finds in the neighbourhood, evidently extended over an area of some square miles from the Bronze Age until Saxon times.

In 1938 a much wider area was trenched—in all about two acres. Ditches were traced, several areas of cobbling or roughly laid chalk blocks were uncovered and one hut floor was examined in detail. No stone-built house of Roman date—the principal objective—was discovered. Three more pits, similar to those already recorded, were excavated, and trenching on the triangular promontory some way from the main site revealed a solitary kiln.

The ditch proved to be shallow and not more than 8–9 ft. across. It must be interpreted as a boundary rather than a defence. Parallel to this, but 108 ft. to the east, was a second ditch, which must be considered part of the same system. All signs of occupation—

huts, floors and pits—lie to the north-east of this system. It is therefore improbable that an undiscovered Roman villa lies westward of the site.

In an otherwise undisturbed area south of the stream, a small kiln was discovered which, from the absence of a stoke-hole pit such as is found in a pottery kiln, is thought to have been an oven for roasting or drying wheat before storage. No part of the superstructure, if any, remains. Sherds found in or near the kiln need not be later than A.D. 120 or thereabouts, and two may be so early as the first century A.D.

Six pits have now been found. Two are double with a central ridge or division separating two hollows. All are relatively large, the largest being 17 ft. 3 in. in greatest length, and 9 ft. 4 in. in greatest width. Every one had been deliberately filled in by tipping in large quantities of wood-ash and dark soil containing charcoal and potsherds. Three were sealed or partially sealed by humps of clay burnt to brick-like hardness. These may have come from ovens or kilns. All are interpreted as storage pits, but two may possibly have been working hollows. The pottery from the pits is of mixed dating. The earliest indicate a date of first occupation late in the first century A.D., while the absence of Signal Station types show disuse before A.D. 370.

It is concluded that the site is that of an insignificant Iron Age village inhabited apparently without interruption from about the middle of the first century A.D. until at least A.D. 500. The chief occupation of the inhabitants was the production of corn. A kiln for the drying or parching of corn, working places where it was prepared for storage, pits for its preservation and an exceptionally large number of hand querns for its grinding are ample evidence for this. In addition, there are unmistakable signs of iron working. Lumps of iron slag on analysis and comparison with known Roman iron slags leave no doubt at all that it is a bloomery slag.

Evidence of regular habitation begins in the first century A.D. A fine piece of *repoussé* bronze work associated with *champlevé* enamel is to be placed in the third quarter of that century. From the pottery it would appear that the Parisii folk who lived here could afford to supplement their home-made pottery by acquiring Roman utensils almost as soon as these were available in the north after the conquest of the Brigantes and the permanent establishment of the Ninth Legion at York. From that time until the end of the fourth century there is no sign of a break in continuity of occupation as attested by coins or pottery. It is possible that occupation continued uninterrupted into pagan Saxon times. Sherds and small objects may date so late as A.D. 500. Hybrid types have suggested "Romano-British women making pots in the Saxon manner for Saxon masters". It is on such a site as this that one might find the enslavement of a sub-Roman population. Not deeply Romanized, they would change masters without serious dislocation in their way of life.

The panel of Celtic ornament from Elmswell, a remarkable example of Celtic art, which was found in 1938, is described by Philip Corder and discussed by C. F. C. Hawkes (*Hull Mus. Pub.*, No. 209; 1940). As it was unstratified and unassociated, its dating depends entirely on internal evidence. It consists of a thin sheet of bronze covered with an embossed design of flowing curves garnished with rosettes, and fitting on, along its upper edge, to an oblong cast-bronze strip decorated with champlevé enamel of a bright orange-red colour, in large part now discoloured green. Beneath comes an iron plate, now incomplete and corroded, which has been bent along its lower margin to form a flange. In all probability it is a panel which ornamented a wooden box or casket. Its dimensions are: length, 5 in.; breadth, 3·1 in. On technological, stylistic and historical grounds, it is assigned to British workmanship under Belgic-Romanizing influence. This conforms to the state of affairs in the Parisian territory of East Yorkshire in, and perhaps some little time after, the second quarter of the first century A.D. The different arguments concerning the style of the panel are summed up as pointing to a date A.D. 50–70, and most probably about A.D. 60 (see also NATURE, 146, 433; 1940).

FORTHCOMING EVENTS

Monday, February 24

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Surgeon-Commander Murray Levick: "The 1938 Expedition to Newfoundland" (Colour Films).

Wednesday, February 26

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Major C. P. Ackers: "Private Estates and Forestry".

Friday, February 28

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. E. E. Bustard: "Preliminary Calculations in Ship Design".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SPEECH THERAPIST to the Yorkshire (West Riding) Education Committee—The Education Officer, County Hall, Wakefield (February 27).

PUBLIC ANALYST to the Soke of Peterborough County Council and the City of Peterborough—The Town Clerk, Town Hall, Peterborough (endorsed 'Public Analyst') (February 28).

PRINCIPAL of the Brighton Municipal Training College for Women—The Education Officer, 54 Old Steine, Brighton (February 28).

LECTURER IN DIETETICS AND ANATOMY—The Principal, Battersea Polytechnic, Battersea, London, S.W.11 (February 28).

ASSISTANT MASTER (GRADUATE) to take GENERAL ENGINEERING SUBJECTS including ENGINEERING DRAWING AND APPLIED MATHEMATICS—The Principal, Twickenham Technical College, Egerton Road, Twickenham (March 1).

ASSISTANT DIRECTOR at the Anglo-Uruguayan Institute in Montevideo—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Uruguay') (March 1).

GRADUATE (MALE) for the English Room, University of Oporto, Portugal—The British Council, 3 Hanover Street, London, W.1 (endorsed 'Portugal') (March 1).

DEPUTY ENGINEER to the Essex Rivers Catchment Board—The Clerk to the Essex Rivers Catchment Board, Essex Rivers House, Springfield Road, Chelmsford (March 3).

HEADMASTER of the Sunderland Junior Technical School—The Director of Education, Education Offices, 15 John Street, Sunderland (March 10).

LECTURER FOR ENGINEERING DRAWING AND OTHER MECHANICAL ENGINEERING SUBJECTS—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1.

LECTURER (MAN OR WOMAN) in the Department of Pure and Applied Science—The Registrar, Loughborough College, Loughborough.

THREE ASSISTANT CONSERVATORS OF FORESTS—The Controller, Sudan Government London Office, Oxford Hotel, 261 Clifton Drive South, St. Annes-on-Sea, Lancs. (endorsed 'Conservator of Forests').

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A BASIS OF INTERNATIONAL CO-OPERATION

IN preparing for the new world order to be established after the War, we must clearly draw whatever conclusions we can from the experience of the last twenty years, seeking to embody the lessons we learnt in the constructive effort of framing a new peace settlement. The truth that nothing short of an economic revolution can give us security has been emphasized by many authorities of widely differing outlook, but the extent to which a foundation already exists for further constructive and creative effort is often overlooked. Notably is this true of the work of the International Labour Organization and of the non-political work of the League of Nations.

The last report of the director of the International Labour Office visualized the important contribution which the organization might make to human welfare even with the outbreak of war, and that forecast has in no way been invalidated with the removal of the Office to Montreal in view of the increasing difficulties of communication between Geneva and member States. From the quarters placed at its disposal by McGill University, as well as from the correspondence offices in London, Washington and Delhi, the organization is continuing its activities, albeit on a reduced scale, as well as assisting in surveying social and industrial changes brought about by the War. Not the least valuable of these activities are the admirable series of publications, including the *International Labour Review*, the *Industrial Safety Survey*, the "I.L.O. Yearbook", and "Yearbook of Labour Statistics", as well as further studies and reports, the issue of which is now to be resumed from the new home at Montreal.

The practical value of the work of the International Labour Organization in preparing peace, emphasized by the Secretary of Labour at Washington in November 1939, has indeed been accentuated as the struggle has intensified, and one country after another has been drawn into the War. The support afforded to the policy adopted by the governing body gives eloquent proof that the organization has an essential part to play at this critical juncture in the fortunes of civilization. That function is essentially a contribution to the preservation of the common heritage of civilization.

"The future of humanity depends upon the type of civilization which emerges from this war, the kind of world institutions which are constructed after it, and the intensity of the allegiance which they command, upon the common man, upon the nature of its impact upon political ideals and upon economic and social practice, upon the manner in which it affects the crisis in social evolution which dominates our time." Nothing which has occurred has invalidated this estimate by the Director of the Office in October 1939, and the existence of this agency for disinterested technical assistance, the concerting of practical measures to limit moral and national havoc within or without the war zone, and to maintain co-operation between Governments, employers and workers represents an immense advance on the forces available for reconstruction available in 1918.

If, indeed, the International Labour Organization represents in some measure that scientific detachment without which we may well be unable to achieve some of the essential reconstruction and rehabilitation, in the non-political achievements of the League of Nations itself there are equally sound reasons for hoping for an advance on the position of twenty-five years ago. To the value of these achievements an admirable article in the American quarterly *Foreign Affairs* by Mr. Arthur Sweetser, a director of the League secretariat, testifies. The League's own reverses, notably in the Disarmament and Economic Conferences and in the Manchurian and Ethiopian disputes, have distracted attention from its solid but less conspicuous successes. This distortion of our understanding of events since 1919 may conceal valuable clues as to the planning and rebuilding which lie ahead of us.

Mr. Sweetser rightly points out that any political institution is a reflection of the society from which it has sprung, and the League of Nations, in particular, has been a vivid expression of the period into which it was born. Its record is valuable both as an index of the stage which international life has at present attained, and as an augury of the course we may expect it to take in the future. The sharp interruption of the varied work of international co-operation carried out at Geneva for two decades, involving the cessation of conferences, drastic reduction of staff, and transfer of some of the technical services, commencing with the financial and economic, to the United States on the joint invitation of the three educational institutions at Princeton—the University, the Institute for Advanced Study, and the Rockefeller Institute for Medical Research—provides indeed a most appropriate opportunity for appraisal of these non-political achievements.

The value of such stocktaking is indisputable, for it is on the assets that remain that the new organization of international co-operation will be built. The need for such co-operation will tend to increase, not only because the ravages of war must be repaired, but also through the relentless advance of science, the continual widening search of industry for specialized materials and the growth of the world's population. Only international organization of the world's life can prevent another and even more calamitous disaster.

The impetus which the League has given to international co-operation is unmistakable. The provision by the League system of a permanent Civil Service supplied with funds and authority, and able to collect and preserve records and statistics, and to enlist and to use the services of experts from all countries, is one of the main reasons for the advances made in the last two decades in handling a wide range of technical questions, from financial and economic problems to the control of opium and other drugs and the consideration on an international scale of health, including nutrition.

Without going into the details of the League's remarkable achievements in these technical fields while international friction was reducing its effective political power to a mere shadow, they present several features which merit attention. A noteworthy part of the financial section and economic intelligence service is the provision of an admirable series of publications which give the world for the first time something of a detached scientific view of the problems covered by the section, in place of the partial or national point of view from which such matters have in general hitherto been approached. The development of this scientific approach and the introduction of something of the scientific spirit into the examination of all these technical matters well justifies General Smuts's observations in his Sidgwick Memorial Lecture. If this is indeed one reason for the success of the League in such technical fields, it may well hold a clue as to the correct approach in other fields also.

A second feature to which Mr. Sweetser directs attention is the unexpected quarters from which the stimulus leading to important advances often comes. The League's first effort in the field of nutrition was made in Japan, where an inquiry was held by the League at the request of the Japanese Government. In this work Australia has taken a leading part, notably through her delegate to the League Assembly, Mr. S. M. Bruce. Moreover, the committee set up under his chairmanship, and known as the Bruce Committee, has already pointed the way forward to social and economic developments of the utmost importance.

Important contributions have by no means been limited to the States members of the League. The success of the League's work in the field of opium and international health has been largely due to the co-operation of the United States. Throughout the last two decades the tendency has been for such co-operation in technical matters to increase, independently of the way in which the political situation might encourage or discourage American co-operation with the League in strictly political affairs. Experience does, indeed, suggest that the United States will be ready, after the War, to take a share in the economic reconstruction on which the hope of the recovery of Europe depends, and that there are no inherent obstacles in the League's organization to the constructive technical and economic work which must proceed side by side with, if not as a prelude to, political reconstruction.

Another significant feature in the technical work of the League which is noted by Mr. Sweetser deserves special attention. Delegates at Geneva handling such problems are often far ahead of their Governments at home. As perhaps might be expected, not only have they a strong sense of the urgency of the problems they are discussing, but also they tend to approach them from the professional point of view, with its desire for constructive and appropriate action. This urge to obtain an adequate technical solution to such problems is reinforced by the larger perspective in which the problems are viewed, and the corporate spirit inspired by the day-to-day process of give and take.

In contrast to this, ministers and officials at home are still in a national atmosphere, subject to all sorts of inhibitions and jealousies. The narrowing of this gap, between what a diplomatist viewing the world as a whole recommends and what a local politician at home is willing and able to accept, is indeed one of the great problems facing the future.

Much is involved in any such efforts at extending the cool, serious, and detached spirit of science into national and international government. The impartial examination of the facts is only the preliminary stage, and perhaps the most elementary contribution which professional organizations, whether of scientific workers or other types of experts, have to make to social advance. A wide vision, minds imaginatively alive to the human issues involved, cool in judgment, and willing, if need be, to sacrifice position or career rather than be false to the truth as they know it, or the vision they have seen—these are first among the qualities which will build us a new and better order. The measure in which they have been revealed in many ranks of society under the searching ordeal through which we are still passing is alike a sure pledge of victory and an earnest that we shall not fail to reap its fruits for all mankind.

BIOLOGY FOR THE MILLION

The Uniqueness of Man
By Dr. Julian Huxley. Pp. xiii+300. (London : Chatto and Windus, 1941.) 10*s.* 6*d.* net.

"THE UNIQUENESS OF MAN" is a book full of good reading, very diversified and occasionally very provocative, like the mind of its author. Julian Huxley is, among other things, the natural successor to Ray Lankester, the ripe and abundant author of "Science from an Easy Chair". These papers vary in quality from the admirable essay which gives the book its title to a cheery little review of "Who's Who", which lines up with its betters as "The Analysis of Fame". Such papers as "Climate and Human History", "The Origin of Species", "The Concept of Race", and "Mice and Men", are exactly what the man of intelligence, mainly preoccupied with other work, needs to keep him up to date with his biological ideas. The concluding three papers are 'religious' and very earnest in tone.

The title paper, written for the *Yale Review*, is done with a carefulness and precision not always evident in Dr. Huxley's fluent writing. It gives an extremely good survey of the profound gulf that has opened between *Homo sapiens* and the rest of the animal kingdom out of which he has arisen in the brief space of at most a quarter of a million years, a mere moment in geological time. This gulf was cleft open by conceptual thought. Already before then the anthropoid apes were an odd outstanding group of animals descending gingerly from the trees; but although their hands were comparatively free, Dr. Huxley tells us, they had no means of transmitting and handing on ideas. Then came words. With conceptual thought man established a mental and moral continuity and a power of assimilating social groups, additional to and far more effective than the links of consanguinity and physical inheritance He developed a novelty in the history of life, "cumulative tradition", and so by means of the word he escaped from the limitations of the small churlish family group hitherto characteristic of other anthropoids. That may not be wholly true. There may have been an intervening phase before the spoken word dominated us, when man had already achieved a certain power over general ideas by means of gesture. Many peoples can still converse by gestures with words as accessories. Man may have begun with gesture and mimicry, with grunts and sounds arising out of his movements. He may have been visual in his communications before he became vocal. He may have drawn and made tally marks long before he used common nouns or numerals in counting.

It is perhaps an impertinence for a general reader to criticize the precision of a distinguished man of science; but occasionally there is a very perceptible laxity and tolerance in Dr. Huxley's phrasing and mental attitude that is not in the best scientific tradition. He says that man has acquired the possibility of a unified mental life. The work of Pavlov and the Behaviourists goes all out to sustain the idea that he is only now acquiring it; and then, lapsing from a psycho-synthetic to a psycho-analytic phraseology, Dr. Huxley speaks of "the forces of disruption". He cannot have it both ways.

Again he seems to me too ready to deal with telepathy and clairvoyance as something new and extraordinary in human experience. But has he really worried out the possibility that the mind may work at times with a swiftness that eludes observation? A friend of mine is a crossword puzzle addict. He tells me that occasionally he can take *The Times* crossword puzzle and write down the solution with scarcely a hitch. At other times he sticks, and, sometimes, even after a considerable effort, he sticks hopelessly. Now *The Times* puzzles are very whimsical and various in their clues, and guessing them means that my friend must run over a very great store of memories, associations, possibilities and alternatives, and put this and that together. There can be no telepathy by means of the printed page. His clairvoyance, I suggest, is just extremely swift clear-mindedness. He flashes to his end and the intermediate steps vanish. The rapid answers of a calculating boy probably fall into the same category of swift reactions with no record of the steps. There is no 'extra-sensory gift' in such cases, but only indications of an enormous range in the pace of our mental processes. The same individual in different phases will vary between what we call intuition and blank impenetrability. Observations on the reactions of a fly to stimuli and of the quick decisions of a frightened cat escaping from some unfamiliar enclosure confirm the idea that ganglionic and brain responses may be immensely accelerated in comparison with everyday humdrum human experience. I am still unconvinced that there is anything quasi-occult in these apparent triumphs of the human mind over the theory of probability.

Let me now hurl a final reproach at the author for his curiously unscientific indisposition to pin himself down to unambiguous statements. His concluding papers on religion are rational and right-minded. I have no quarrel with their general trend. But this is how he winds up:

> "I believe that we can never reduce our principles to any few simple terms. Existence is always too various and too complicated. We must supplement principles with faith. And the only faith that is both concrete and comprehensive is in life, its abundance and progress. My final belief is in life."

Here we are supposed to cheer and disperse in a mood of edification. I refuse to do so. What does this belief in life mean? We are alive. How can we avoid believing in life? What is the alternative? Is this an assertion that, to put it vulgarly, "life is O.K. for me"? How can one accept that nowadays? I can understand the stoic's stern pride in the life within himself. I can understand the scientific worker's devotion to truth—truth with the utmost possible precision at any cost—for how can one be a man of science without that? I can understand the man whose head is "bloody but unbowed" under the bludgeonings of chance. Maybe Dr. Huxley will reply that he agrees with all that? Then why cannot he bring himself to say so quite distinctly?

H. G. WELLS.

BIRDS OF LUNDY

Lundy: Isle of Puffins

By Richard Perry. Pp. 268+24 plates. (London: Lindsay Drummond, Ltd., 1940.) 12*s.* 6*d.*

FOR five months during the spring and summer of 1939, Richard Perry lived on the island of Lundy, an Atlantic island off the coast of Devon, in order to study the birds. Day after day, and even into the deepening dusk, he watched and observed them, and in this book are gathered together his notes.

Never, perhaps, have sea birds been studied so minutely during the whole of their nesting season, and Mr. Perry shows that he possesses to an unusual degree the gift of keen and accurate observation. The sea birds most fully described are the puffin, kittiwake, razorbill, guillemot, and cormorant. There are interesting chapters on the birds of passage and on the island's history. The book is illustrated by thirty-seven photographs by Alan Richardson, and some of them—for example, those of the kittiwakes—are remarkably beautiful.

The author was able to watch the epic journeys of the young of razorbill and guillemot to the sea from their nesting ledges. I quote a graphic passage (p. 139) on a young razorbill's first flight :

> "Shortly after nine o'clock [on the evening of July 17] one mystery was solved when an old razorbill came down from the top of the gully some two hundred feet up, accompanied by a big chick which made a perfect flight down, its diminutive wing stumps whirring as swiftly as a bee's, its little paddles spread wide in the appropriate manner. A 'scarl' of excitement from other razorbills lining the route extolled its triumph."

This young razorbill was accompanied by one of its parents. But what of a youngster who makes this first flight unattended ? The tragedy which then follows is vividly portrayed on pp. 143–144 :

> "At a quarter past nine [at night] a chick suddenly appeared from nowhere in the water at the bottom of the gully and swam directly out to the open sea, crying its continual 'psee-ee-ee, psee-ee-ee', with wide-open bill. For some minutes it plied around outside the entrance to the gully, often looking up at the cliffs ; but no parent came to meet it. Its fate was inevitable, for it was still quite light, with a fine sunset reddening the North Cape. I waited sadly. Down came the accursed gull, as deadly quick as ever. And though the little fellow dived, and though three guillemots, waiting on their own chicks flighting down, made an onslaught on the gull, the latter hooked him by one shank and carried him dangling to a nearby reef. Then the monster beat and tore the life out of him savagely, though he struggled valiantly and with astonishing tenacity."

That the author can write well and vividly may be realized from his description of kittiwakes (p. 92):

> "It is during the intervals of comparative quiet that a marvellous thing happens, when, suddenly, hundreds of kittiwakes zoom down from the ledges at a single impulse, shoaling out of the gully in a dazzling white and grey pack that has an hypnotic effect on the eye. Like snowflakes in a blue heaven, they wheel mazily over the whirlpools of white surf and the deep green Atlantic swell. By what miracle of flight-control do they avoid collision ? One will sometimes drop its brown webs and buffet another with its furled wings. And then with one accord the hundreds wheel around and soar up to their ledges in the gully. Their tumultuous clangour when they alight is almost overwhelming."

Take, again, his description (p. 59) of the first landing of the puffins on Lundy in March :

> "While I sat for hours half hidden, an unbroken column of red-billed, red-webbed puffins hurtled with menacing directness at my boulder, swaying from side to side on the gale : like streams of tracer bullets radiating to their respective boulders seventy yards up and down the Slope. Sheering off easily, without shock, from my head, with a soft flutter-thud of keeling wings, the short black leaf-points of their spread tails projected fanwise on either side of their scarlet or orange shanks, as they turned to plane down to the sea with great *élan*.
>
> "Hovering delicately, with flickering wings and hanging rose paddles, some pitch neatly on to their boulders, bowed forward into the wind, like turnstones, with great bills uptilted and convex wings lifted for some seconds well above the level of their backs in the manner of an alighting beetle, before standing fair and square on their vermilion shanks, so brilliant against the dull green and yellow lichen of the grey rock. But they soon take off again, drooping at head and stern, with perfect swallow-dives, and quiver like black hawk moths down the Slope : red webs, clasped together, stretched out behind, delicately fluttering wings arched a little convexly—a most graceful, fragile motion. They circle swiftly out over the sea, often mounting to four or five hundred feet with quick-beating whirring wings, and rejoin the throng of their fellows flighting like a scattered swarm of starlings hawking winged-ants."

There is a fine description, too, of the departure of the young guillemots from their ledges (p. 178 *et seq.*).

When the author can write so well, it is something of a shock to come across his lapses of style. For example, on p. 95 an account of the doings of kittiwakes brings the dreadful opening of a sentence, "As per usual", which shatters the flow of vivid narrative. The author, too, is fond of long and strange words : "exteroceptively" (p. 212) ; "territoried" (p. 184) ; "pre-incubationary" (p. 121) are examples. What is a "black-sitting" egg (p. 125) ? Nor is his habit of naming the greater black-backed gull the "great gull" or the "big gull" one to be commended.

It is of considerable interest to realize that the Lundy shags build their nests and lay so late in the season. Mr. Perry found that the first nest-building in 1939 took place on April 28, and the first egg (by the way, he is wrong in describing the shag's egg as "glossy") was not laid until May 24 (p. 218). In the north of Skye, a full 400 miles north of Lundy, I expect to find shags brooding their eggs by the first week in April, and have seen nesting material brought as early as February.

In his chapter, "Home from the Sea", the author advances an interesting theory to account for the periodic return, from mid-winter onward, of sea birds to their nesting rock. That ocean bird, the fulmar, I myself have seen at its breeding rock in early January, when the ground was hard frozen, and icicles hung from the cliff edges.

It is refreshing that the War should have failed to stop the publication of this book, which must be a source of interest, and of pleasure, to all bird lovers. SETON GORDON.

SCIENCE, NATIONAL AND INTERNATIONAL, AND THE BASIS OF CO-OPERATION*

BY PROF. A. V. HILL, O.B.E., F.R.S., M.P.

ONE of the great tasks lying before scientific people after the present War will be to rebuild, and to rebuild on a firmer and better foundation, the international scientific organizations which have come into being in the last seventy years, particularly during the present century. The earliest of these was the International Bureau of Weights and Measures, established in 1873. An International Geodetic Association followed, and in 1903 an International Seismological Association on the same lines. Arising from the initiative in 1898 of the Academies of Munich and Vienna, together with the Royal Societies of Göttingen and Leipzig, which had all been in the habit of meeting annually, the Royal Society of London undertook to approach a number of foreign academies with a view to the formation of an international association of academies. As an independent institution, not subject to State control as were so many of the academies, the Royal Society was in a very favourable position for opening such negotiations. As a result the International Association of Academies was formed, which held five meetings in all, the sixth at St. Petersburg being cancelled owing to the outbreak of war in 1914. It never met again.

These meetings were not limited to natural science, many of the academies being concerned both with the scientific and the humanistic side of learning. It is interesting to interpolate that as one result of this movement, and in order to represent Great Britain on the literary, philosophical and historical sides, the British Academy was formed and incorporated by Royal Charter in 1902.

Just before the end of the last war, in 1918, representatives of the academies of all the allied countries met in London, and later in Paris, to discuss the formation of a new international scientific organization. In July 1919, the first General Assembly of the International Research Council, as it was to be called, met in Brussels. Representatives of the Central Powers were not invited, and a misunderstanding which then arose was made an excuse for declining an invitation which was sent to each of them a few years later. This unfortunate state of affairs persisted. German professors who feel themselves insulted are difficult people to appease, and indeed the fault was not all on their side. International Unions for Astronomy, Geodesy and Geophysics, Chemistry and Mathematics (this last no longer in existence) were formed; and at the next General Assembly in 1922, for Physics, Scientific Radio, Geography and Biology. Some of these Unions have functioned well and have held important international congresses and done important work; others have done little. The ones that have worked best, for example, Scientific Radio, are those which had a more practical international task to fulfil.

These Unions always had an official or semi-official flavour: official delegates, official hospitality, official finance, official business, have tended to put independent science into a somewhat subordinate position. Physiologists have held international congresses for fifty years, and great value these have had, as we who have taken part in them know: but physiologists have always insisted that they came as independent men of science, to meet, to hear and to discuss things with their colleagues; not as representatives of some State institution or interest. Other scientific groups have held similar informal congresses based on the same idea. There is grave danger, as was found by the Physiological Congress meeting in Italy in 1932, and in the Soviet Union in 1935, of a congress being used as an opportunity for political propaganda; in 1938 this was altogether avoided by the tact and understanding of Swiss colleagues, as it had been avoided at meetings prior to 1932. Political considerations are hard enough to avoid anyhow, but they are much worse if a congress is not genuinely independent.

In Great Britain and in the United States, the strength and the high position of the independent scientific societies make it easy for them to take charge of the proceedings of a congress, or of an inquiry of international importance, without danger of State control—either in appearance or reality. But this is not so easy—indeed it has been impossible in recent years—in many countries. In order to preserve the integrity of science in our own country, it is very important that those strong independent scientific bodies should be maintained; and for the sake of international scientific relations it is desirable that in other countries also, so far as we can influence them, the domination of the State over science should be tempered by public appreciation of the part played by independent scientific agencies and institutions.

In some form or other, not one may hope

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* From an address given at the annual general meeting of the Parliamentary and Scientific Committee on January 28.

exactly in their present form, these international unions must be started up again some day. This time, at any rate, we shall not be prevented from following our better judgment by the intransigence of French colleagues; though it may be hard enough for us this time to take a detached view. My own feeling is that in this matter we should rely, so far as possible, upon the help and advice of our American scientific friends. Their views about science, for its own sake and in relation to the State, are much the same as ours, and they (at present at least) are further from the battle. I know they would regard it as a sacred trust of friendship to bear a large part of the burden of starting off again the international co-operation in scientific endeavour which was so unhappily ended by the events of the last years. There is a high idealism in the United States about international co-operation in the field of science and learning, and a very great regard for British science and British scientific men. If the War goes ultimately as we expect, in the downfall of dictatorship and tyranny, it will be our job to start off again, on broader and better lines, the complex system of international scientific co-operation; and in starting it off I am sure that we shall be able to call for the help and co-operation, without stint or limit, of our scientific friends in the United States.

I have spoken several times of the necessity of guarding the independence, the spiritual integrity of science. In many countries to-day science is wholly subservient to the State; its soul is not its own. I do not deny for a moment the importance, indeed the necessity, of scientific organizations within the framework of Government, or of liberal support by the State of scientific research. One can only welcome such recognition by the public of the importance of scientific knowledge and scientific discovery—and ask for more. There are several things, however, which one may fear. First, the condition of stagnation and complacency which tends to develop in any scientific department or establishment which is cut off from outside criticism or ideas; we have far too many examples of this already, and if we are not careful they will multiply. Secondly, the danger that science will be planned by administrators in offices instead of by young men with their sleeves rolled up in laboratories or workshops. Thirdly, the disadvantage of separating teaching from research, to the great loss of the next generation, who may miss the inspiration of seeing discovery going on in the places where they are taught. Fourthly, a decrease in the influence and prestige of those independent scientific bodies which play so large a part in the social and intellectual activities of the scientific community and provide the cross-connexions between groups which might otherwise be isolated. Fifthly, the danger that he who pays the piper may call the tune, and that research may be required to be devoted primarily to objects which the politician, or the Civil Servant, regard for the moment as of national importance; or even—as in Germany and the Soviet Union—to bolstering up theories which the official philosophy of the State prescribes.

To avoid all these troubles, the independence and integrity of science must be carefully preserved; in the universities, in the learned societies, in the various associations or institutions devoted to the advancement of knowledge. Whenever State support is given, a buffer should be interposed, similar to that provided by the University Grants Committee between the universities of Great Britain and the Treasury. In our existing Research Councils (Department of Scientific and Industrial Research, Medical Research Council, and Agricultural Research Council), working with Government funds, the buffer is already provided by the fact that the members of the Councils are chiefly independent scientific men. The same safeguard exists at present with much of our State-aided research; we must carefully watch that the strength of this safeguard is fully maintained, that it does not become a formality, and that the principle is consciously extended wherever possible, as the financial burden of scientific research and development is taken over (as is bound to happen more and more) by the State.

In many of the departments of Government, however, notably those of the defence services, scientific research is undertaken, on a grand scale, which cannot be controlled directly by outside independent bodies. In these establishments particularly, the danger of stagnation and complacency exists. They are devoted to specific service purposes, often of necessity secret; and the condition of secrecy prevents them, in ordinary times, from attracting many of the ablest and brightest minds, who prefer the freer atmosphere of the universities, the possibility of discussing and publishing their results, and the recognition of their colleagues resulting therefrom. Consequently, in war, those who direct these establishments are often men who have arrived at their positions by seniority and long service, during which they have been largely isolated from the ideas and criticism of current scientific thought; it has been difficult for them not to become officials rather than working men of science. When an emergency occurs, as at present, numbers of able men come in, but to posts in which they can exert relatively little influence, and their ability and imagination may for long be imperfectly used. This indeed is inevitable under the present system, for they have at first no experience of service conditions and needs. After a year or two perhaps—longer than necessary—these able people find their proper level, but not until much damage has been done by lack of imagination and energy in the posts they might have filled before.

To avoid this trouble—and it is a very real one—two main principles may be applied. First, to introduce into each department or organization some kind of scientific advisory council, similar to that which on the whole works so well now in the Ministry of Supply. This council should consist partly of independent scientific men chosen for their special knowledge on one hand, for their wide contact with the scientific community on the other; and partly of official scientific people representing not only the department or organization itself, but also a variety of other departments, so that a good cross-section of official knowledge and experience is available. Secondly, in ordinary times to arrange for regular interchange of personnel between the Government research establishments and organizations, and the universities and other independent institutions in which research is carried on.

I know that this second proposal will shock some of those who have lived in the traditional secrecy of service science; but it is right all the same. Why should not a chemist or mathematician from Woolwich, a physicist from the Signal School, an engineer from the Royal Aircraft Establishment, go back as a lecturer or professor to a university, or to the research staff in a commercial laboratory; just as a physiologist from the National Institute for Medical Research, or an aeronautical engineer at the National Physical Laboratory, or a zoologist at the Marine Biological Laboratory at Plymouth, may do? And why should not the research workers in Government laboratories be just as regular attendants at the meetings of scientific societies as those in other institutions?

The first need is for a common pension scheme. All scientific workers, whether in the universities, or in commercial laboratories, or in Government employment, should come under the Federated Superannuation System for Universities, as do those employed by the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Council. Then the Departments should insist on sending their people away at intervals, to carry on research elsewhere and to refresh their souls in institutions outside. Conversely, they should invite outside scientific workers (naturally under proper safeguards of secrecy when necessary) to work for corresponding periods in their establishments. The advantage of this second step would be that the importance and interest of the problems which are being tackled in Government establishments would be more commonly realized, and better men would be inclined to take part in their solution. In the defence services a reserve of officers and other ranks is an essential part of an efficient organization for war; in the scientific services similarly, a reserve of research workers, for the case of emergency of any kind, would seem to be equally essential.

One great advantage of working in the scientific establishments either of the Government or of a large company or corporation, is the fact that equipment is not limited below the minimum that is necessary for efficiency. As regards research in the universities of Great Britain, I should feel inclined, if a Government fund of say one million pounds were available for scientific research, to ask the University Grants Committee to allocate it to different universities. Each university would then deal with the disposal of the sum allotted to it, in much the same way as the Royal Society does with the Government Grant for Scientific Investigation; and as in the last few years the University of London has already done with a substantial fund which it has put aside for this very purpose from its own resources. I know from long experience, both personally and by helping to administer the Royal Society grant, the great advantage to the individual and to the institution where he works, of the possibility of obtaining a grant, possibly large, more often small, for a specific research project; to be expended by the young research worker (or the older one) at his discretion and not merely by the department. What the University of London has made a start in doing in this way, can be done by other bodies; but money will be required. In the days of straitened circumstances which we cannot but foresee ahead, it must come from the State if scientific investigation is to be kept up—as it must be; and the natural body to allocate it to its different claimants among the universities would be the University Grants Committee.

For research in industry, in medicine and in agriculture (apart from their overlap with university institutions) the machinery for similar grants exists already in the three Research Councils; with extended financial provision from the Treasury if necessary. In industry, at least part of the sum required should be subscribed by the industry itself, as it is at present, with the research associations devoted to various subjects and working in co-operation with the Department of Scientific and Industrial Research. The personal grants given at present by the latter Department for researches "of particular timeliness and promise" are of great value and could with advantage be extended.

THE FAUNA OF NEW ZEALAND

By H. Barraclough Fell

NEW ZEALAND has provided biological science with the classical and most striking case of the effects upon a fauna of prolonged isolation. For an immense period of time it has remained a sanctuary for archaic types. The facts about the kiwis, ground-parrots, wekas and other flightless birds are quoted in perhaps every zoological course in the universities of the world. Yet, these very animals so important to science are now in the gravest danger of becoming extinct[1] like the giant eagles and moas before them. The aid of zoologists in Britain and elsewhere is urgently needed to support the efforts being made by New Zealand workers to bring about reforms to save these animals, which, once lost, will never be known again. It is insufficient to have passed laws purporting to 'protect' them, when inadequate wild-life administration is available to enforce the laws. Active measures must be taken as soon as possible to destroy the complex of introduced pests which have ousted, or actually attacked, the defenceless native species. The problem is of the utmost importance, and we owe it to future generations, and especially to future biologists, not only in New Zealand but also throughout the rest of the world, to solve it now.

Last year New Zealand celebrated the first centenary of organized settlement. The time is opportune, therefore, for a general survey by qualified workers to ascertain the present position of the native animals and plants after one hundred years of contact with European forms. Such a survey would be in the interests of biologists everywhere, and its commencement should be urged by overseas societies. There is in existence already, in the Forest and Bird Protection Society of New Zealand, an organization capable and willing to undertake the work if sufficient support were forthcoming. The survey, if undertaken, would aim not only at establishing clearly the detrimental factors which have operated upon native forms during the period of settlement, but would also be concerned with finding effective remedies for the ills which are now besetting this unique fauna and flora, and with urging the adoption of the remedial measures by the Government. Despite the efforts of New Zealand biologists (notably the late Dr. Leonard Cockayne, the late Mr. H. Guthrie-Smith, and the Forest and Bird Protection Society), apathy has prevailed so long that it seems that only pressure from overseas can bring the country as a whole to realize the gravity of the position. Collaboration between New Zealand biologists and others (especially those working throughout the British Commonwealth) to decide a policy to be pursued, with concrete suggestions for a method of approach based on the facts ascertained from a wide and thorough survey, will do more to convince the New Zealand Government of the urgency of the matter than anything else.

The present position was expressed by Dr. C. G. Morice and Mr. B. C. Aston in April of last year, when they wrote: "Much has been said, but nothing done so far, in setting on foot a scheme to bring about improvement in the administration of wild-life matters. Opposition has, on the other hand, come from those bodies who receive revenue from licenses for the killing of fish and game. Thus we have the same old story, that an attempt is being made to sacrifice the interests of the majority of sportsmen on the altar of personal interest. In the meantime this Society continues to receive a large number of reports indicating ruthless poaching, illegal collecting, and other breaches of the existing Act, and, we fear, must expect to continue to receive such, in the absence of an adequate warden service. The waste of funds expended on guesswork decisions continues as in the past, and points more than ever to the need for adequate research by trained observers in the field."[2]

The value of national parks has been urged constantly by the Society,[3] and gradually such parks are being set up. The famous Tongariro National Park, in the North Island, took its origin in a gift to the nation from the Maori chief Te Heuheu. It has since been increased in area by the efforts of the Royal Society of New Zealand. As the introduced vermin, however, are still at large, much of the value of these areas remains incapable of realization. For example, in the Mount Cook National Park the flora is still being ravaged by the chamois and thar introduced for tourist publicity purposes, while the effect of weasels on the fauna of the same area has been described by A. P. Harper[4]. The back-country mountain ranges have, to some extent, acted as conservation areas by virtue of their difficult access. It has been proposed to celebrate the centenary by opening up a scenic highway in the Tararua Ranges, near Wellington. Realizing the danger to the native fauna and flora from fire and interference, the Forest and Bird Protection Society has made an effort to oppose the plan[5], which as yet, apparently, has not been put into operation. Kāpiti Island is an example of successful conservation on a small scale, but unfortunately is exceptional.

Some actual facts may be quoted to illustrate the tragic spoliation which is at present taking place. In 1925 the Forest and Bird Protection Society urged upon the Government the need for reservation of the Auckland Islands on account of their remarkable sub-antarctic bird fauna, particularly the nesting grounds of the albatross. The Government of the day refused on the grounds that the annual rental of the islands as a sheep station (£40) was of greater value than the avifauna. In 1934, after the sheep project had proved a costly failure, the Government officially reserved the islands. The sheep, however, are still there, and the destruction goes on[6,7].

It has been estimated that there are a million cats in New Zealand, many of them having gone wild; probably some ten million birds are destroyed every year by these animals alone[8,9]. A cat belonging to a lighthouse keeper has destroyed an entire species (the endemic Stephen's Island flightless wren)[10]. Weasels and stoats rob the nests of the flightless wekas—birds which serve as protectors of other native species owing to their destruction of rats[11]. As the weka declines in numbers, so the rats are increasing, and the native birds grow fewer and fewer. Every year many kiwis and wekas fall victims to the traps of the opossum-hunters[1,12]. Wild pigs, dogs, and human interference have combined to make kiwis scarce in all but the remotest areas.

The evils of badly conducted acclimatization are notorious in the case of the rabbit. Not so well known overseas are some of the other examples which are having an equally disastrous effect upon the native fauna. The unfortunate introduction of the German owl by the Otago Acclimatization Society has burdened the country with a voracious pest which does not hesitate to attack and kill fantails, warblers, tomtits and other small native birds[13,14]. The native owl, or morepork, awaits darkness before beginning to hunt, and thus does not attack native birds. The introduced Australian black swan supplants the less vigorous native duck and teal by taking their food. Shooting by sportsmen has also reduced their numbers, and in this particular matter the present Minister of Internal Affairs has repeatedly warned the acclimatization societies of the need for conservation[15]. The draining of the swamps deprives the pukeko of its natural haunts, and drives it into the open, where it is shot by thoughtless sportsmen. The warnings of naturalists on this matter[16] have gone unheeded.

Man himself has committed great evils against the native fauna, and still is doing so. Reischek and his fellow commercial collectors of the last century filled the museums of Europe with the dried or stuffed skins of New Zealand's rarest birds. Their native country, alas, knows the living species no more. Thus was lost the huia (*Heteralocha acutirostris*), a bird unique in having radically different skull-forms in the two sexes. Mistakes such as these will not be repeated. But in the matter of commoner species, destruction is still going on, and other species may yet be extinguished by man. Thus, every year all species of shags are shot by fishermen on the supposition that they eat trout. The Forest and Bird Protection Society has shown that only one species, the black shag, is responsible; but the shooting goes on[2]. Godwits are shot every year during migration when they gather at the North Cape before making their six thousand mile flight to Siberia[17].

In an attempt to replace the forests which had for too long been allowed to be depleted, thousands of acres of quick-growing *Pinus radiata* and other exotic conifers were planted. No native plants grow on the darkened, needle-covered floors of these artificial forests; there is no native bird-life where there are no natural berries for them to eat[18,19]. The Nothofagus forests on many of the ranges are now dying or already dead owing to the introduced deer stripping the bark from the trees with their antlers, and destroying the absorbent mosses of the sub-alpine forest floor[20,21]. In the train of this destruction has come erosion, and in this matter the Government has been forced to act[22,23].

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[1] *Forest and Bird*, **45** (1937).

[2] Annual Report, Forest and Bird Prot. Soc. (1939).

[3] *Forest and Bird*, **53** (1939).

[4] Harper, A. P., *Forest and Bird*, **40** (1936).

[5] *Forest and Bird*, **45** (1937).

[6] *Forest and Bird*, **44** (1937).

[7] Guthrie-Smith, H., "Sorrows and Joys of a New Zealand Naturalist" (1936).

[8] Pearson, T. G., *Forest and Bird*, **31** (1933).

[9] *Forest and Bird*, **43** (1937).

[10] Oliver, W. R. B., "New Zealand Birds", p. 441 (1930).

[11] Guthrie-Smith, H., "Tutira".

[12] *Forest and Bird*, **38** (1935).

[13] *Forest and Bird*, **37** (1935).

[14] McCaskill, L. W., *Forest and Bird*, **23** (1932).

[15] *Forest and Bird*, **51** (1939).

[16] *Forest and Bird*, **40** (1936).

[17] Kirk, Major J. R., *Forest and Bird*, **41** (1936).

[18] *Forest and Bird*, **45** (1937).

[19] Collins, G., *Forest and Bird*, **41** (1936).

[20] *Forest and Bird*, **48** (1938).

[21] *Forest and Bird*, **39** (1936).

[22] Bulletin No. 77, Department Scientific and Industrial Research, Wellington (1939).

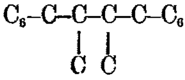
[23] *Forest and Bird*, **54** (1939).

NOTE.—*Forest and Bird* is the quarterly journal issued by the Forest and Bird Protection Society, Wellington. The society is formed under the patronage of Viscount and Lady Galway and the Maori Bishop of Aotearoa.

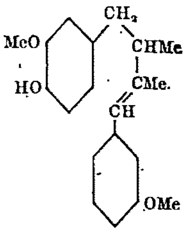
CONSTITUENTS OF NATURAL PHENOLIC RESINS

By Prof. R. D. Haworth,

University of Sheffield

THE resinous secretions and deposits of plants are frequently resolvable into crystalline carboxylic acids, alcohols and phenols of terpenoid or *n*-propylbenzenoid (C_6–C_3) structures. Abietic acid and the amyrins are examples of terpenoid constituents, and cinnamic acid and coniferyl alcohol represent C_6–C_3 types. The widespread occurrence of the C_6–C_3 structure in plant pigments, essential oils, amino-acids, alkaloids, resins, etc., is of special interest in connexion with the natural phenolic resins, from which a group of compounds possessing the skeleton structure,  $C_6\text{–}C\text{–}\underset{\underset{\displaystyle C}{|}}{C}\text{–}\underset{\underset{\displaystyle C}{|}}{C}\text{–}C\text{–}C_6$, has been isolated. These substances occur in many natural orders of plants, but their frequent association with the heartwoods and exuded resins of the Coniferæ is noteworthy. The term 'lignan' was introduced[1] to include all substances containing this carbon framework, derived from the combination of two C_6–C_3 units at the β-carbon atom of the C_3 chain. The lignans are catechol derivatives differing in the degree and kind of alkylation of the phenolic groups and in the state of oxidation of the non-aromatic portion of the molecule. The structural formulæ and natural sources of the lignans are included in the accompanying formulæ, where a convenient classification into three sub-groups, *a*, *b*, and *c*, is adopted.

(*a*) Diarylbutanes

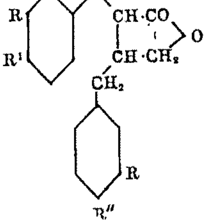


(I)

Lignans:

l-Guaiaretic acid
l-Dihydroguaiaretic acid $(\text{–}\underset{|}{\text{CH}}\text{–CH}_2\text{–}$ for $\text{–}\overset{|}{\text{C}} = \text{CH–})$

Occurrence: *Guaiacum officinale* (wood)

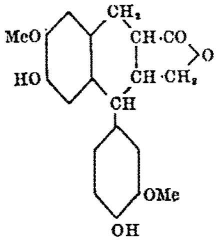


(II)

Lignans:
l-Matairesinol (R = OMe ; R′ = R″ = OH)
l-Hinokinin (RR′ = RR″ = CH_2O_2)
l-Arctigenin (R = R″ = OMe ; R′ = OH)
l-Cubebin (RR′ = RR″ = CH_2O_2 ; with CHOH instead of CO)

Occurrence:
Podocarpus spicatus (wood)
Cupressus obtusa (wood)
Arctium lappa (seeds)
Piper cubeba (seeds)

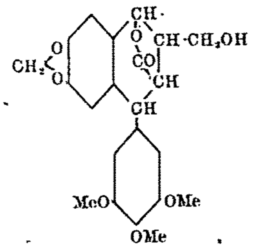
(*b*) Tetrahydronaphthalenes



(III)

Lignan: *l*-Conidendrin

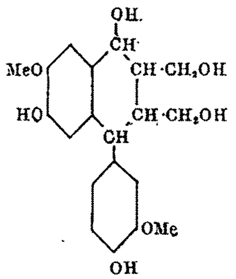
Occurrence:
Waste sulphite liquors
Tsuga Sieboldii (wood)
Picea excelsa (wood)
Podocarpus spicatus (wood)



(IV)

Lignan: *l*-Podophyllotoxin

Occurrence: *Podophyllum peltatum* (roots)



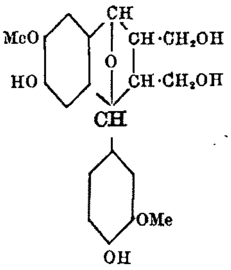
(V)

Lignan: *d-iso*Olivil

Occurrence: *Olea Cunninghamii* (wood)

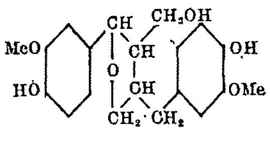
The ethers of the three sub-groups, *a*, *b*, and *c*, are attacked by nitric acid in different ways; the diarylbutanes give dinitrolignans, the tetrahydronaphthalenes yield amorphous products of unknown constitution, and the tetrahydrofurans are degraded to 4:5-dinitroveratrole[2]. Reduction at the benzyl ether linkages is characteristic of the tetrahydrofurans, and the dimethyl ether of *d*-pinoresinol (VIII) may be reduced either partially to the dimethyl ether of *d*-lariciresinol (VII) or completely to the *l*-diol (IX; R = CH_2OH)[3]. The diarylbutanes and tetrahydronaphthalenes are also distinguishable by oxidation of the lignan ethers; the former are degraded to substituted benzoic acids, and the latter yield a substituted *o*-benzoylbenzoic acid and a dibasic acid of type (X; R = CO_2H)[4]. Furthermore, smooth dehydrogenation of tetrahydronaphthalenes can be effected with lead tetra-acetate[5], and the conversion of the methyl ether of *l*-conidendrin (III) into the lactone (XI) orientates the lactonic group of conidendrin and excludes an alternative based on structure (XII).

(c) TETRAHYDROFURANS



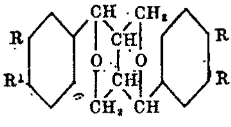
(VI)

Lignan: *l*-Olivil
Occurrence: *Olea europea* (resin)



(VII)

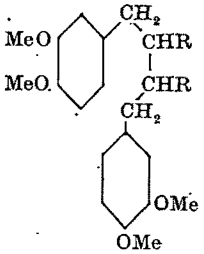
Lignan: *d*-Lariciresinol
Occurrence: *Larix decidua* (resin)



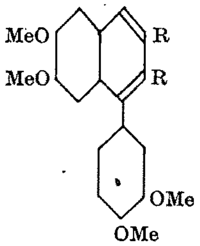
(VIII)

Lignans:
d-Pinoresinol (R = OMe; R′ = R″ = OH)
l-Eudesmin (*l*-pinoresinol) dimethyl ether (R = R′ = R″ = OMe)
d-Forsythigenol *epi**pinoresinol) monomethyl ether (R = R′ = OMe; R″ = OH)
d-Sesamin (RR′ = RR″ = CH_2O_2)
l-Sesamin
l-Asarinin *epi**sesamin)
Occurrence:
Pinus nigra, Pinus silvestris and *Picea abies* (resin)
Eucalyptus hemiphloia (kino)
Forsythia koreana (leaves)
Philyrea latifolia (bark)
Sesamum indicum (seeds)
Asarum Sieboldi
Asarum Sieboldi, Asarum Blumei Duch.

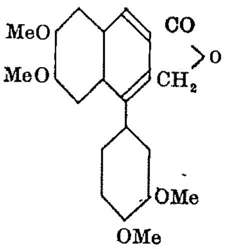
* *epi*Pinoresinol and pinoresinol differ in the stereochemical configuration at one or both of the α-carbon atoms.



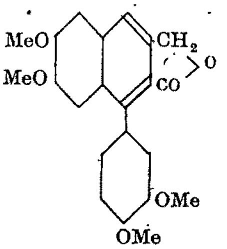
(IX)



(X)



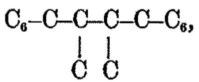
(XI)



(XII)

The dimethyl ethers of *l*-guaiaretic acid (I), *l*-olivil (VI), *d*-*iso*olivil (V) and *d*-lariciresinol (VII) are converted into the substituted naphthalenes (X; R = Me), and the dimethyl ether of *d*-pinoresinol (VIII) into the furan (XIII), on heating with selenium[6]. This reaction is not applicable to methylenedioxy lignans; but these may be related to the corresponding methoxy derivatives by demethylenation and subsequent methylation.

Derivatives of types (X), (XI), (XII), and (XIII) retain all the carbon atoms of the lignans, but lack the optical activity associated with the natural products. Methods for the synthesis of compounds of types (X; R = CO_2H or Me)[5,7] (XI)[8], (XII)[9,10], (XIII)[6] and (XIV; a degradation product of *d*-lariciresinol)[11] have been developed, and the inactive lignan derivatives have been identified by comparison with synthetic specimens. The establishment of the structures of these lignan derivatives provides a proof of the presence of the fundamental carbon framework,

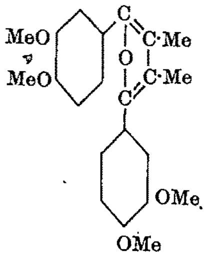


$$C_6{-}C{-}\underset{\substack{|\\ C}}{C}{-}\underset{\substack{|\\ C}}{C}{-}C{-}C_6,$$

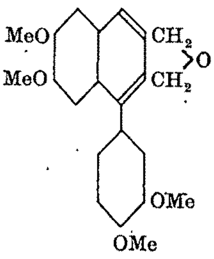
which applies rigidly to all products represented by formulæ I–VIII. A synthesis of the optically active modifications of type (II) has also been introduced and applied to the synthesis of *l*-matai-resinol and *l*-hinokinin[12]; but complete syntheses of other optically active types are not available. Numerous partial syntheses have, however, been realized by interconversion of members of the lignan group, for example:

$$\begin{tikzcd}
l\text{-cubebin} \arrow[r, "(13)"] & l\text{-hinokinin} \arrow[r, "(14)"] & l\text{-matairesinol} \arrow[r, "(15)"] & l\text{-conidendrin} \\
 & & d\text{-pinoresinol} \arrow[r, "(3)"] & d\text{-lariciresinol} \arrow[u, "(16)"']
\end{tikzcd}$$

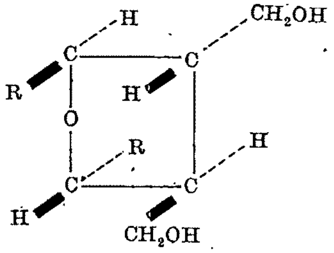
The lignans present an interesting stereochemical problem in which some advance has been made. Natural lignans of type (II) are synthesized from optically active anyhdrides of dibasic acids of type (IX ; R = CO_2H)[12], and unless optical inversion occurs during the reaction, a *trans* configuration must be assigned to the product. The hydroxy-acid obtained from *l*-matairesinol is partly converted by hot alkali into a diastereosomeric modification, and comparison[10] of the rates of lactonization of the two hydroxy-acids supports the *trans* configuration of *l*-matairesinol. The presence of asymmetric centres at one or both of the α-carbon atoms is an additional complication in the tetrahydronaphthalene and furan subgroups, but there is considerable evidence that the matairesinol configuration of the β-carbon atoms is retained throughout the lignan family. The conversion of the methyl ethers of *d*-pinoresinol and *d*-lariciresinol into the *l*- (and not *meso*-) form of the diol (IX ; R = CH_2OH)[3] supports this view.



(XIII)



(XIV)



(XV)

The proof that the phenolic groups are symmetrically disposed in *l*-olivil[17] and *d*-pinoresinol[18], together with the optical activity, shows that these molecules, whilst lacking planes, centres and alternating axes of symmetry, must possess a symmetry axis. Numerous configurations are eliminated by these requirements, and the remaining structures (two for each lignan) retain the matairesinol configuration at the β-carbon atoms. Little information is available concerning the configuration at α-carbon atoms. Cinnamic acid and coniferyl derivatives occur naturally in the stable *trans* form, and Vanzetti[19], postulating that lignans arise from the union of two coniferyl molecules, has proposed the *trans* structure (XV ; R = guaiacyl) for *l*-olivil. A comparison of the properties of the four modifications of 1-phenyltetrahydronaphthalene - 2 : 3-dicarboxylic acid[20] suggests that the most stable acid possesses *trans* linkages in the 1 : 2- and 2 : 3-positions, and this conclusion inferred from a compound containing three asymmetric centres is consistent, so far as it goes, with the *l*-olivil structure (XV).

Although the synthesis of lignans from C_6–C_3 types has not been reported, the widespread occurrence of the unit and the formal analogy of the coniferyl-lignan to the terpene-diterpene relationship indicate the importance of the C_6–C_3 unit in the construction of natural products. Tri-coniferyls, corresponding to the triterpenes, are unknown ; but the few established structural features of lignin chemistry are consistent with the view that lignin represents the polyterpene of the C_6–C_3 metabolism. The absence (or small proportion) of phenolic groups in lignin suggests, however, an important difference in the mechanisms of the hypothetical polymerizations of the C_6–C_3 type to lignans and lignin respectively.

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OBITUARIES

Prof. Miles Walker, F.R.S.

DR. MILES WALKER, emeritus professor of electrical engineering in the University of Manchester, whose virile personality, sometimes tempestuous, always lovable, endeared him to all, passed peacefully away on January 22, at the age of seventy-three. Prof. Walker had by no means relinquished the strenuous life in favour of a country retirement, so well earned and so open to acceptance in the delightful home he had chosen amongst the Cotswolds at Amberley. The tale of Walker's career sounds strange unless one realizes the intense persistence which was so marked a characteristic in him.

Trained originally for the law, and in fact fully qualified and in practice in a solicitor's office in London, Walker found the lure of physics and engineering irresistible; this urge had been kindled and then thwarted when, as a boy, he browsed in his father's library in such books as Fownes "Chemistry", and visited his engineer uncle at Naworth Collieries, only afterwards to be articled to solicitors in Carlisle. Jumping the traces then in 1891, he registered as a student under Sylvanus Thompson and John Perry at Finsbury Technical College, London, being considerably older than his fellow students, and indeed continuing to pursue his law practice for a time.

To Walker the lectures proved fascinating, and he was delighted to find himself actually handling the tools, instruments, and machines he had read about. There was then no turning back for him. It is doubtful whether Walker had any preconceived career in mind when, in 1896, after acting as personal research and literary assistant to Sylvanus Thompson for three years, he proceeded to Cambridge to read for the Natural Sciences Tripos and afterwards the Mechanical Science Tripos, gaining a first in each (1898–99). It happened just then that the British Westinghouse Co. was inquiring from Prof. J. A. Ewing for engineering students whom it could send for a while to the works of the Westinghouse Electric and Manufacturing Co. at East Pittsburgh in the United States, to form upon their return a technical nucleus at the newly established Trafford Park Works. Walker joined that party of some forty and proved to be an outstanding member.

Walker's work at Trafford Park, as designer of alternating current machinery during the period 1903–12, refused to be trammelled by accepted traditions of design, and such innovations as the multiple radial commutator for high-speed D.C. generators, the locally saturated cylindrical rotor of self-regulating turbo-alternators, and novel features in rotary convertors and phase advancers came forth prolifically. But how could Walker but kick against the traces in a commercial organization with its necessary restrictions! Keen as he ever was for the practical, he found his real niche upon accepting in 1912 the chair of electrical engineering at the School of Technology, Manchester, that is, under the Faculty of Technology of the Victoria University, but retaining touch with practice by acting as consultant to his old firm—afterwards named Metropolitan-Vickers Electrical Co. Ltd.

Many examples could be given of Walker's persistence and nursing of a problem for years; for example, the identity of mathematical relationship subsisting between fundamental quantities in gravitational and electromagnetic problems had often caused him to question whether there might not be a gravitational effect corresponding to mutual induction. He had pondered on this at least as early as 1899, and the advice of authorities in Cambridge at that time had not definitely discouraged experimental work, but his first opportunity to investigate occurred after taking up professorial work in 1912, when he started a research student upon the problem. Using a 480-lb. vertical spindle flywheel as inducing mass, close to but elaborately shielded from a 23-lb. porcelain disk as receiver carried by a bifilar suspension from the top of the building, Walker was able to determine (Walker and Stainer, *Phil. Mag.*, **32**, 592–600) that if any such mutual inductive effect existed, the ratio of change of moment of momentum induced to that inducing it, must be less than 5×10^{-10}, a result reached only after a succession of precautionary measures.

It was typical of Walker that, pleased as he was with the final determination of this minute upper limit, his concern for his research student became pronounced lest the negative nature of the result should detract in fact from the assessed value of the investigation in the matter of academic award to the student.

During the War period, 1914–18, Walker was an active member of the Lancashire Anti-Submarine Committee, but he also devoted much attention to other war problems of his own devising. In 1924, when Sir Ernest Rutherford at the Cavendish Laboratory needed to produce very large momentary magnetizing forces, he turned naturally to his friend Walker, asking him to advise Dr. Kapitza. Walker was able to make valuable suggestions in the matter and to arrange for the work to be suitably placed. This plant later formed part of the equipment of the Mond Laboratory at Cambridge.

Throughout his life, Walker was an idealist impelled by very strong convictions and conclusions, arrived at, he believed, with unanswerable logic. He was in consequence sometimes difficult in debate although always transparently honest and sincere. These ideas were often unconventional and ranged over the whole spectrum of human welfare; thus his address as president in 1932 of Section G to the British Association started on an engineering basis but was soon frankly given over to a humanistic review, and even so had been much expurgated by Walker, regretfully, but upon previous official advice. Walker was an ardent supporter of the M.K.S. system of units, of rationalized spelling of English, and of universally available cheap electric supply.

Walker married in 1903 Miss Eveline Sargent, and they later adopted two boys in whose education and up-bringing they jointly found much pleasure. The boys are now serving in the fighting forces. Walker married in 1935 Miss Valeria D. Ellis, who survives him.

Walker was an untiring author, having served a notable apprenticeship during his association with Sylvanus Thompson. His best-known books are: "The Specification and Design of Dynamo-electric Machinery", "The Diagnosis of Troubles in Dynamo-electric Machinery", "The Control of Speed and Power Factor of Induction Motors", "Conjugate Functions for Engineers". He served as special lecturer at the Imperial College of Science and Technology in 1911, and at the Massachusetts Institute of Technology in 1921. A. B. Field.

Sir John McFadyean

We record with regret the death of Sir John McFadyean, formerly principal of the Royal Veterinary College, who died on February 1 at the age of eighty-seven.

John McFadyean was born on June 17, 1853, the second son of Andrew McFadyean of Barrachan, Wigtownshire. He received his early education at the Ewart Institute and later proceeded to the Royal (Dick) Veterinary College, Edinburgh, from which he was admitted to membership of the Royal College of Veterinary Surgeons in 1876. On obtaining his diploma he was appointed lecturer in anatomy at the College and while so engaged attended classes at the University of Edinburgh as a medical student, graduated bachelor of medicine and master of surgery in 1882 and bachelor of science in the following year. In addition to his teaching in anatomy, McFadyean turned his mind to pathology and bacteriology, subjects then in their infancy. In 1892 the curriculum of veterinary education was extended from three to four years, and far-reaching changes were made in the general standard of education. McFadyean, who had already made a name for himself by his work on tuberculosis, was appointed professor of pathology at the Royal Veterinary College, London, and two years later became principal, which office he held until 1927.

There are few diseases of the domesticated animals to which he has not contributed valuable information, and numerous select committees and Royal Commissions have been largely guided and assisted by his knowledge and experience. He was a tireless worker, and for many years his private researches were carried out during the night hours. In 1888 he founded the *Journal of Comparative Pathology and Therapeutics*, in which much of his work is recorded.

McFadyean was a great principal and a great man of science; but he will be best remembered by a grateful profession as an equally great teacher, for he possessed eht rare gift of imparting his knowledge to his students in a manner which was readily understandable. By his work he showed nearly half a century ago that there were new and wider fields of veterinary science to be explored. His researches into diseases affecting animals in tropical and sub-tropical countries as well as in Great Britain and in Europe, created what has now come to be known as preventive veterinary medicine and by his teaching he provided the pioneer workers in this new field. We owe it to his sound knowledge and foresight that the veterinary profession was prepared to move in this direction far in advance of official demands.

In 1893 McFadyean was elected a member of Council of the Royal College of Veterinary Surgeons, and was president of that body from 1906 until 1909 and again during 1930–31 on the occasion of the meeting of the International Veterinary Congress in London, "McFadyean's Congress" as it was called by the eminent foreign delegates who attended from all parts of the world. During the forty-seven years that he served on the Council, McFadyean's personality dominated its deliberations, as it did the field of veterinary science, and the profession owes much of its solid progress through that difficult period to his wide knowledge of men and matters. On his retirement from the principalship of the Royal Veterinary College in 1927 he was elected an honorary associate of the Royal College of Veterinary Surgeons, the highest honour that that body could bestow, and in 1933 he received the first award of the diploma of fellowship *honoris causa*. After his retirement Sir John pursued his studies with unabated enthusiasm, absorbed almost until the end in his great life-work for veterinary science.

In 1883 he married Mara Eleanor, eldest daughter of Thomas Walley, principal of the Royal (Dick) Veterinary College, Edinburgh. She died in 1929. He leaves three sons and two daughters, to whom we offer our sympathy in their bereavement.

J. B. Buxton.

Mr. C. Thurstan Holland

On November 5, 1897, less than a year after the discovery of X-rays, a paper on the subject was read by Sylvanus Thompson at a meeting which was held to inaugurate the formation of the Roentgen Society. Among those present at this meeting were a few medical men who decided to devote themselves to the application of the new discovery to the needs of medicine. Of this very small band Thurstan Holland was one, and within a few years he had become the most eminent exponent of this new branch of medicine in Great Britain. He was elected president of the Roentgen Society in 1904 and again in 1916. In his address on the latter occasion he wrote: "It is twenty years since I took my first radiograph, twenty years brimful of interest, and of advances which in those days none of us could have even dreamed about, advances which may perhaps be illustrated by the fact that the first successful radiograph I saw taken [by Oliver Lodge in January 1896] was that of a hand, and the exposure was

1¾ hours". He lived to see such exposures made as a routine in 1/10 second, even with apparatus that was mobile and could be readily taken round the wards to the patients.

In the rapid evolution of medical radiology and its applications to almost every branch of medicine and surgery, particularly in urinary radiology, Thurstan Holland took a leading part. He was one of the first to demonstrate the presence of a stone in the kidney and to obtain the shadow of the kidney outline as a *sine qua non* of a satisfactory radiograph of the kidney region. His meticulously careful technique and expert knowledge of photography resulted in the production of radiographs that were far in advance of standard practice for many years. Moreover, he brought to the task of the interpretation of his results exceptional clinical experience that was coupled with logical and rapid judgment. Little wonder, therefore, that he made his mark not only as a pioneer but also as a leader.

Although he practised in Liverpool, he nevertheless found time to keep in close touch with his colleagues in London, where he served on almost every radiological committee of importance. His commanding presence and outstanding personality were asociated with an exceptional rapidity of judgment and a knack of getting down to essentials· His influence on committees was profound.

Thurstan Holland's contributions to the literature of medical radiology were numerous and covered a wide field. So early as 1898–99 he wrote on the successful treatment of lupus and eczema by means of X-rays. Later he turned his attention to the diagnosis of chest conditions and those of the urinary tract. Working with his friend the late Sir Robert Jones, he made many valuable contributions to the study of diseases and abnormalities of bones. The Royal College of Surgeons acknowledged the value of this work by electing him as a fellow of the College. A list of about a hundred of his papers up to 1922 lies before me, covering practically every field of medical radiology that had been explored up to that time.

During the War of 1914–18 Holland served as a Major in the First Western General Hospital. His common-sense methods in the localization of foreign bodies were adopted by many radiologists.

He attained to all the honours that were possible in his branch of medicine and was president of the Electro-therapeutic Section of the Royal Society of Medicine, of the Roentgen Society (twice), of the British Institute of Radiology, and, highest honour of all, was elected president of the First International Congress of Radiology in 1925.

Outside his profession his hobbies were alpine photography and mountaineering. During the last fifteen years of his life he lived in retirement; but he still took an active interest in radiology and, as *doyen* of the radiologists, he attended many of the public functions until ill-health supervened. With his passing on January 16 at the age of seventy-seven, radiology has lost a leader, the last of the pioneers, who did much to establish this branch of medicine on a sound basis. A. E. BARCLAY.

Prof. T. R. Wilkins

NEWS has been received of the sudden death on December 10 of Prof. Thomas Russell Wilkins, professor of physics in the University of Rochester, New York. He was in his forty-ninth year.

Born in Toronto, Canada, he graduated at MacMaster University and came to Great Britain for post-graduate work at Cambridge. Before going to Rochester he held teaching posts at the University of Chicago, and at Brandon, Canada.

When the Institute of Applied Optics was founded at Rochester in 1928, Wilkins was placed in charge, and the success of the Institute owed a great deal to his interest and enthusiasm. His main scientific interests were always, however, in the realm of atomic physics, and he recently relinquished the optics post in favour of Prof. Brian O'Brien.

Wilkins was an enthusiastic research worker and his main line consisted in the study of cosmic ray and radioactive processes with the aid of photographic emulsions, a technique to which he made notable contributions, but not without long and laborious hours at the microscope.

Prof. K. F. Wenckebach

PROF. K. F. WENCKEBACH, an eminent Viennese physician and a founder of modern cardiology, whose death has recently been announced, was born at The Hague on March 24, 1864. After serving as an assistant at the Institute of Zoology and Pathology of Utrecht, he was appointed professor of internal medicine at Groningen in 1901, where he remained until 1911, when he was transferred to the corresponding chair at Strassburg. He held this post until 1914, when he was appointed professor of medicine at Vienna, retiring in 1929. He at first devoted his attention to embryology, but his subsequent work, for which he is best known, was concerned with the pathology and clinical aspects of cardiovascular disease and particularly cardiac arrhythmia. In 1920, in association with Prof. Jagic, he founded the *Wiener Archiv für innere Medizin*, of which his students offered him a *Festschrift* on the occasion of his retirement in 1929. During the occupation of his chair at Vienna he attracted a large number of practitioners and students interested in cardiology. He had many friends in Great Britain, where he was elected an honorary fellow of the Royal College of Physicians in 1928 and of the Royal Society of Medicine in 1930. J. D. ROLLESTON.

WE regret to announce the following deaths:

Sir Frederick Banting, K.B.E., F.R.S., professor of medical research in the University of Toronto, on February 21, aged forty-nine.

Prof. William J. A. Bliss, emeritus professor of physics in the Johns Hopkins University, on December 27, aged seventy-three.

Dr. J. G. Priestley, reader and demonstrator in clinical physiology in the University of Oxford, on February 9.

NEWS AND VIEWS

Charles Chree Medal and Prize

THE Charles Chree Medal and Prize, founded by Miss Jessie Chree in memory of her brother, the late Dr. Charles Chree, is to be awarded biennially to men of science who have contributed to the advancement of knowledge in those subjects in which Dr. Chree was particularly interested, and to which he had made signal contributions. The responsibility for, and the administration of, the award has been placed by Miss Chree in the hands of the Physical Society, and the Council of the Society has made the first award of the Medal and Prize to Prof. Sydney Chapman. Many minds in many countries have contributed to the advancement of the science of geomagnetism, and there are few branches of physics in which international co-operation is more desirable. British physicists have played a full part in the development of the science—Norman, Gilbert, Halley, Sabine (may we claim Lamont ?), and Chree himself, are outstanding names.

Prof. Chapman's contributions to the science are many and distinguished. His investigations of the diurnal variations and the separation of the solar and lunar effects have involved the handling of a mass of observations the magnitude of which has been well described as appalling. Prof. Chapman has analysed these observations with characteristic skill, devising new methods for the attack on this vast mass of data. Very important additions to our knowledge of the mechanism of the variations have resulted from Prof. Chapman's work. His analyses of the changes occurring in magnetic storms have resulted in a corpuscular theory of the origin of the storms. He has made weighty contributions to the critical literature of the subject and his latest volume, "Geomagnetism", written in collaboration with Prof. Bartels, is likely to remain for a long time the most detailed and authoritative treatment of the subject. The motto, *Sol rotatur magnetica respondet terra,* appears on the reverse of the Chree medal. This is a fitting comment on one aspect of the work of the recipient of the first Chree Medal.

Mrs. C. Neville-Rolfe, O.B.E.: Snow Medallist

As announced in NATURE of January 25, p. 114, Mrs. Neville-Rolfe has been awarded the Snow Medal by the American Social Hygiene Association. The medal is given annually for distinguished services to humanity. This was the first time the medal has been awarded outside the United States, and the only occasion on which it has been given to a woman. Mrs. Neville-Rolfe has been not without honour in her own country, but her qualities of courage and service have been, perhaps, more clearly seen by those interested in the promotion of social welfare in the great American republic. She is the eldest daughter of the late Admiral of the Fleet, Sir Cecil Burney, Bart.; her husband is Commander Clive Neville-Rolfe, who is at present on active service; while her brother is Commander Sir Dennistoun Burney, Bart, also on active and special service. Courage, therefore, comes naturally to her, and during the War of 1914–18 she saw where certain work was necessary, where no one else was doing it. It was not easy or popular work, and brought a good deal of prejudice to those who formed what is now known as the British Social Hygiene Council to fight one of the most serious and insidious forms of illness which, during and after the War of 1914–18, created considerable havoc both among individuals and homes in Great Britain.

Since that time, Mrs. Neville-Rolfe has been distinguished in pioneering effort, she has covered the whole country of Great Britain, lecturing, interviewing and organizing. She has taken her message overseas to Malta, Cyprus, India, Malaya, Hong Kong and the West Indies, and the Colonial Office has shown its appreciation of her work. She has visited and lectured in the United States, and is widely known as an eloquent and impressive speaker and as a pioneer in social welfare. It is good at this time to see that British and American people and organizations are appreciating each others qualities of service, and the bestowal of the Snow Medal on such an outstanding woman of Great Britain by the American Social Hygiene Association is a gratifying proof of this development.

Education in Social Hygiene

WHILE various professional organizations are interested in the vocational aspects of biology in education, and others are associated with certain special parts, it has been left to the Educational Advisory Board of the British Social Hygiene Council almost alone to concern itself with the value of biology as a medium of genuine education for people of all types and of all ages. Over the last three years, during which he has held the position of education officer to the Board, Mr. T. H. Hawkins has been working for a more generous appreciation of biology in the schools. His work has brought him into constant touch with educational authorities in all parts of the country, and much of his time has been taken up with conferences and discussions of problems of teaching technique. In recent months he has been active in the new movement for the service of youth, giving talks to adolescent boys on personal development and human biology. His position has been one calling for personal initiative, human insight, knowledge of public administration, and ability to get on with people of all shades of opinion.

Now, in relinquishing his post to take up an educational appointment in Trinidad under the Colonial Office, he is presented with a fresh field for his endeavours, in which problems of human biology appear in a clearer light than they do at home, even if differing only in degree. His experience of biology in education in England should help to give a fresh interpretation to teaching practice in the Colonial Empire. Mr. Hawkins is to be succeeded by Mr. H. C. Bibby. Mr. Bibby entered Queens' College, Cambridge, in 1931 and became College Prizeman in 1933, graduating in 1935. He has examined the flora of the hot springs of Iceland, and was awarded the degree of M.Sc. of the University of Liverpool for ecological research. He is the author of research papers and nature study articles. He has been science master in Oulton School, Liverpool, and senior biology master in Chesterfield Grammar School. He has the advantage of considerable experience in organizing camps and in various other forms of youth work. His appointment to Mr. Hawkins's important though difficult post seems a very happy one.

Presidency of the Institution of Mechanical Engineers

MR. ASA BINNS, the retiring president of the Institution, was born in Keighley, Yorkshire, in 1873, and was educated at the Grammar School, Keighley, and at the University of Leeds. His workshop training was obtained at the works of Messrs. Tannett Walker and Company, Leeds, and Messrs. Cole, Marchent, and Morley, Ltd., Bradford. After a period as draughtsman in Ipswich with Messrs. Ransomes, Sims, and Jefferies, he joined the staff of the Hull docks of the then North Eastern Railway in 1898, thus beginning an association with dock work which has since been continuous. A few years were spent with the Admiralty Works Department, and in 1906 Mr. Binns was appointed to the London and India Docks Company, and remained with the Company's successor, the Port of London Authority, until his retirement from the post of chief engineer in 1938, when he was retained as consultant. He is now consultant to Messrs. Rendel, Palmer, and Tritton, consulting engineers. He has been a member of the Institution of Mechanical Engineers since 1902. He contributed a paper on "Recent Developments in the Mechanical Equipment of the Port of London Authority" (*Proc.*, 122, 575; 1932) which was presented in May 1932 at the spring meeting of the Institution in London. Mr. Binns became a Whitworth exhibitioner in 1896.

Mr. W. A. Stanier has been elected to succeed Mr. Binns as president of the Institution of Mechanical Engineers. He has been a member of Council of the Institution for many years. He served his apprenticeship with the Great Western Railway at Swindon, and reached the position of principal assistant to the Chief Mechanical Engineer of that Company. His outstanding ability as a locomotive engineer was emphasized by a striking decision of Lord Stamp in appointing him chief mechanical engineer of the London, Midland and Scottish Railway, straight from his position as principal assistant at Swindon. It is particularly fitting that the chief locomotive engineers of Great Britain should follow their famous predecessor, George Stephenson, in the president's chair.

The Right Hon. Lord Harlech, G.C.M.G.

WHEN Lord Harlech takes up the office of High Commissioner in South Africa, to which his appointment was announced on February 21, he will enter upon his duties with a long experience of affairs and a judgment matured and affirmed by an intimate knowledge of the problems of British dependencies, and more especially of those of Africa, such as has been possessed by none of his predecessors in this high and important position. As the Hon. W. G. A. Ormsby-Gore, after serving as intelligence officer in the Arab Bureau and assistant political officer on the staff in the Middle East during the War of 1914–18, and holding several minor but important political appointments in the early years which followed the armistice, he became successively Under-Secretary of State for the Colonies, Postmaster-General, First Commissioner of Works and Secretary of State for the Colonies. In the office last named he brought to the problems of the colonial dependencies the firm conviction that scientific study and the application of the results of scientific research are essential to promote the prosperity of the Colonies themselves, and advance the interests and well-being of the inhabitants, whether European or indigenous.

Lord Harlech's acquaintance with conditions in the dependencies, gained by a personal inspection in most of them, was wider in range than that of any of his predecessors in office, and where Africa was concerned was reinforced by the detailed knowledge which had come with his experience as chairman of the East African Parliamentary Commission of 1924, and as the British representative on the Permanent Mandates Committee of the League of Nations. Lord Harlech's retirement from office after the death of his father in 1938, owing to his increased responsibilities, was felt by his colleagues and by all concerned with or interested in Colonial administration to be a great loss to the public service. His solicitude for the antiquities of England and Wales, and his services to British archæology while First Commissioner of Works, must be passed over here, but they are well known. Lord Harlech is an elected trustee of the British Museum and chairman of the governing body of the School of Oriental Studies in the University of London. He has also served as president of the Geographical Association and of Section E (Geography) of the British Association, as well as vice-president of the Museums Association.

Materials for Pest Control

IN 1937, several national industrial organizations, being impressed by the disturbing frequency of infestation of warehouses, granaries, mills and other structures of high capital value, and of ships, lighters, rolling stock, sacks and all other equipment essential to storage, process and transport, as well as by the heavy loss in value and destruction of foodstuffs, etc., set up an informal conference, under pledges of co-operation, with the object of establishing improved conditions. Infestation not being inherent in the commodities but being introduced in the links of the chain of trade, it was clearly essential to get general agreement on concerted action. Where standards were low or absent, proof was not lacking that there was a constant injection of infested commodities into the trade stream. At the outset it was recognized that control of the condition of the country's imports would have to commence in the countries of export, and that the aid of Government was necessary. It was also recognized as a first essential in that direction that definite indication should be given that the house here was being put in order. The most important and easiest step was that ordinary principles of cleanliness should be inculcated. This could be achieved largely by the exercise of commercial prudence. The owner of the commodity and the owner of the structure or equipment could be more mindful of their duty to each other, and the force of competition could be used to raise standards. Restraint on landing and isolation of fouled commodities again were really matters of commercial prudence, but as the most desirable precautions, if left to voluntary effort, could be offset by the recalcitrant or indifferent, something more substantial than the play of commercial prudence was needed. There remained the respective parts of the applied biologist and the chemist. Control of infestation of stocks or structures necessitated prolonged research. In this respect it was fortunate for the conference that these very matters had for a long time past been the special preoccupation of the Stored Products Laboratory of the Imperial College of Science and Technology; although it was to be regretted that that work in more recent times had suffered greatly and been circumscribed by lack of recognition.

The conference laid its problem before the Government early in 1938, and by the end of that year, decision had been taken for the establishment of a permanent research and advisory organization under the Department of Scientific and Industrial Research, industry making substantial grants towards the cost. The Department accepted the generous offer of the Imperial College to place the Stored Products Laboratory at Slough available, and the new organization inherits the benefit of the past work of the laboratory. The Department also established the Standing Conference of Co-operating and Contributing Industrial Organisations, and appointed as its chairman Mr. W. McAuley Gracie, the chairman of the former informal conference and the initiator of the industrial effort. Prof. J. W. Munro, the former director of the laboratory, has become the consultant to the Department, whilst retaining his chair in the College. This desirable conjunction of science and industry was effected prior to, and the organization was available at, the outbreak of war. In the course of the industrial investigations it has become apparent that immediate attention should be given to the establishment of a comprehensive case for guidance in production, research and application as relating to insecticides, fungicides, raticides and repellents for all purposes. Several scientific advisers to and in Government Departments have been consulted, and they fully agree as to this. Certain sectional pieces of work have been done, and available information can be lifted out of dormancy, but there are gaps to be filled and a general harmony to be established, so that economic decisions may be taken and lines of research indicated. Mr. Gracie has requested Mr. W. V. Blewett, who has been released by Imperial Chemical Industries, Ltd., for this purpose, to carry out at once an economic and technical survey of the demand and production of these materials, with special reference to the potentialities and requirements of the British Empire and friendly States. Communications should be addressed to Mr. Blewett, at 42 Hamilton House, 155 Bishopsgate, London, E.C.2.

The Universities and Man-Power

AT the annual meeting of the Court of Governors of the University of Birmingham, the Vice-Chancellor, Dr. Raymond Priestley, paid a tribute to the attitude of the Government in recognizing the importance of the part the universities can play in the war-time economy of Great Britain. This has been directed towards the avoidance of the waste of young men of high educational attainment and intellectual promise which was so lamentably characteristic of the War of 1914–18. Dr. Priestley regards this attitude as "one of the few signs of progress we can see in a backslidden generation". But in the last few weeks, things have taken a turn for the worse. In times of crisis, when the immediate needs fill the foreground, there is a real danger that we may take a too shortsighted view. The stream of science, and applied science, graduates has so far been undammed; the trouble here is the great increase in the demand. But Dr. Priestley wonders now whether we have been wise in diminishing the flow of graduates in commerce, art, and law. The Government clearly has not changed its university policy, and intends to safeguard the situation as well and as promptly as it can.

"The real menace to our future is the air training scheme. No one in his senses will grudge to the R.A.F. to-day the lion's share of the flower of the nation's youth. Nevertheless, this scheme, reaching, as it does, right down into the schools, is the real danger the universities face to-day. Its success is a measure of the essential soundness, the grit, the adventurous spirit and the imagination of British youth. But this does not decrease the universities' dilemma, as they foresee the loss of their raw material for 1942 and later war years. Some of these lads, outstanding in character and intellect, who are to-day flocking to the R.A.F., should be saved from their own enthusiasm. For the sake of the nation's future, they should be directed into the universities".

Government Grant to Universities

SPEAKING in reply to a question by Mr. K. W. M. Pickthorn (University of Cambridge), Sir Kingsley Wood, Chancellor of the Exchequer, recalled that, in view of the vital part played by the universities in the life of the community, the importance of maintaining so far as possible the standards of university education and the essential contribution which the universities are making in a variety of ways towards the national effort, it was decided to maintain the provision for the current year at the same level as that of 1939, namely, £2,149,000. These considerations, he said, have lost none of their force, and despite the increasing strain on the national finances the Government, after considering a report from the University Grants Committee, have reached the conclusion that if the universities are to continue their present contribution to the national effort the provision for 1941 must be maintained at the existing level. He expressed the hope that local authorities will take similar action.

Precautions against Blister Gas Attacks

As a precautionary measure, which is being taken to cope with the possible use of blister gas by the enemy in aerial attacks on Great Britain, pharmacists are to be asked to provide supplies to the public of 'bleach cream'. The Ministry of Home Security, which has been in collaboration with the Pharmaceutical Society, is responsible for the scheme. Briefly, the Ministry has invited all proprietors of pharmacies, by a letter addressed to each one of them, to make 'bleach cream' available for members of the public in the event of blister gas being dropped in the vicinity of their pharmacies. The plan is quite simple; it is that the proprietor of each pharmacy, having been provided by the local authority with two enamel pails and a supply of 'tropical bleach' for the preparation of bleach cream, should, when and if gas is first used, place the pails furnished with cream on the pavement outside his shop with a poster instructing the public how to apply it. No charge would be made to the public, and it has been agreed with the Pharmaceutical Society that pharmacists should be asked to perform this service without payment as part of their contribution to the national effort.

An Ichthyosaurian Fossil

ACCORDING to a report published by the daily Press, a nearly complete skeleton of an Ichthyosaurian, or fish-shaped fossil reptile, has been found in the shaft of the Hermann Göring Mine in the northern Harz Mountains. It is to be studied by Prof. J. Weigelt, of Halle, who estimates its length as 5·10 metres, or nearly 17 feet. Such well-preserved large skeletons are very rare and difficult to extract from the rock in a perfect state. The largest Ichthyosaurian skeleton in the British Museum, which was obtained from the Lower Lias of Lyme Regis, Dorset, would measure about 24 feet in length when it was complete. Several known Ichthyosaurian skulls from the Lias belong to individuals which must have been at least 30–40 feet long. One of the finest of these large skulls, from Lyme Regis, is exhibited in the rooms of the Geological Society of London at Burlington House.

Classification of Ships and Machinery

THE Thomas Lowe Gray Lecture to the Institution of Mechanical Engineers on January 24 by Dr. S. F. Dorey was on the "Progress in Marine Engineering as Influenced by the Classification of Ships". The classification of ships sprang out of the ancient practice of marine insurance, and has been in vogue for nearly two centuries. There are many classification societies; but the best known is Lloyd's Register of Shipping of which Dr. Dorey is the chief engineer surveyor. These classification societies serve the interests of shipowners, shipbuilders, engineers, underwriters and others, and each of them has rules relating to the construction and maintenance of ships and their machinery. Giving a sketch of the development of marine machinery since the earliest steamboats, Dr. Dorey traced the rules by which Lloyd's Register has influenced progress. From the first specification for machinery, right through the period of its construction and at regular periods during its life, Lloyd's surveyors have duties to perform, and the whole shipping industry owes much to the impartial and exceptional way those duties are performed. From its very constitution a classification society is strictly impartial; it is a form of voluntary control of an industry by the industry for the general well-being.

Factory Canteens

THE Factory (Canteens) Order of the Minister of Labour, whereby all factories doing Government contract work and employing 250 persons are required to provide canteen facilities either in or near the workshops, has opened up new problems to the management of factories (*Electrician*, Jan. 17). In the first place, factory meals will, of necessity, be inexpensive, and of the various cooking processes involved, boiling and steaming will be in preponderance for such items of diet as stews, steamed puddings, rice and vegetables of various kinds. Ample steaming oven accommodation must therefore be made for the large quantities of steamed food, and steam boiling pans for greens, stews, etc. Electric cooking has the advantage that the air is not vitiated by the products of combustion, and ventilation problems are, therefore, usually less acute. The usual number of air changes per hour normally allowed for a kitchen is of the order of 20–60; this could be modified, depending on the provision for natural ventilation. In using electricity for thermostaically controlled instantaneous boilers to deliver water near boiling point, it is best to arrange that the demand occurs during the peak period of the load on the public power station.

Molybdenum and Tungsten in the Caucasus

IT is announced by "Russia Today" Press Service that large molybdenum and tungsten works have been opened recently in Kabardino-Balkaria, in the Caucasian mountains. The plant is situated at the foot of Mount Tyrny-Auz. Soviet geologists began to prospect for ores on this mountain in 1934. At an altitude of 9,850 ft. they discovered large deposits of rich molybdenum and tungsten ores. Owing to the situation of the Tyrny-Auz deposits, however, the extraction of the ores has presented a difficult problem, and local weather is severe. Everything about the workings is mechanized. The ore, which is extracted by means of electric drills, is brought away from the face by electric trains, sent to the surface by conveyer belt and lowered to the works at the foot of the mountain by cable hoists. The ore mine has four electric power stations and a central air-compressing station. There is an electric sub-station underground. The nearest centre to the new works is Nalchik, capital of Kabardino-Balkaria.

Detection of Toxic Gases

We have received a copy of Leaflet No. 12, "Methods for the Detection of Toxic Gases in Industry: Organic Halogen Compounds" (H.M. Stationery Office, 1940. 2*d.* net). Ten substances are covered, including tetrachloroethane, pentachloroethane and carbon tetrachloride. One of the most toxic of the group is tetrachloroethane. The method of detection is by the use of a special lamp burning pure alcohol in a supply of the air under test. The halides are decomposed and react with a small copper screw in the nozzle of the lamp, giving a green coloration to the flame.

Marie-Alfred Cornu, For.Mem.R.S. (1841-1902)

On March 6 occurs the centenary of the birth of the distinguished French physicist, Marie-Alfred Cornu, who for thirty-five years held the chair of physics at the Ecole Polytechnique and who in 1896 was elected president of the Paris Academy of Sciences. Born at Chateauneuf, near Orleans, he had a brilliant career as a student at the Ecole Polytechnique and the Ecole des Mines, and was made a professor at the former at the age of twenty-six. His investigations carried out in the next ten or fifteen years raised him to the highest rank of experimentalists. Using Fizeau's methods he re-determined the velocity of light; with Baille, in the cellar of the Ecole Polytechnique, he re-determined the density of the earth, and among his memoirs of this time were some on the theory of electrostatics in which he explained the potential theory of Gauss and Green, then little known in France. His later work included valuable researches in spectroscopy. He was admitted a member of the Paris Academy of Sciences in 1878 as successor to A. C. Becquerel, and in the same year received the Lacaze Medal, and also the Rumford Medal of the Royal Society. In his own country he served on the Bureau des Longitudes, and as president of the International Commission of Weights and Measures. He was a foreign member of the Royal Society, and an associate of the Royal Astronomical Society. As Rede Lecturer at Cambridge in 1899, he discussed "The Wave Theory of Light and its Influence on Modern Physics". He was not only a successful experimentalist and a leader in scientific thought, but also a great teacher. He died on April 11, 1902. Three years later the French Physical Society struck a medal in his honour.

The Night Sky in March

The shortening night reaches equality with the day at the spring equinox, March 21d. 0h. U.T. The moon is full on March 13 and new on March 27. A partial lunar eclipse occurs at the full and an annular eclipse of the sun at the time of new moon, but both eclipses are invisible from Great Britain. A notable occultation takes place on March 5, when both the disappearance and reappearance of α Tauri (Aldebaran) can be favourably observed subject to weather. As seen from Greenwich, the disappearance of the star behind the moon's unilluminated edge (moon near first quarter) is at 19h. 16·1m. at position angle 108° from the north point of the moon's image; the subsequent reappearance is at 20h. 29·1m. at 242°. On March 8, λ Geminorum is also occulted, the disappearance seen from Greenwich being at 21h. 20·4m. at position angle 97° (Add 1 hour to all these times to read in Summer Time.)

Of the planets visible this month, Jupiter and its close companion, Saturn, are in the western sky at sunset; they are not far from the moon's slender crescent on March 3 and 30. Mars continues as an early morning star, in the constellation of Sagittarius. The planet is moving about 3 minutes of Right Ascension per day eastwards amongst the stars. Venus and Mercury are now stars of the dawn, being in conjunction with each other on March 3 at 13h. Mercury reaches greatest western elongation (28°) on March 25, but Venus is drawing towards the sun's place until superior conjunction on April 19. In mid-March, Sirius souths about 1 hour after sunset.

As night sets in, the bright stars of the familiar winter constellation are declining westwards. Amongst the less spectacular constellations east of the meridian is Coma Berenices. This constellation contains a loose cluster of stars which, about March 15, comes to the southern meridian at 2h. summer time at an altitude of 65°. East of this cluster is the position of the north galactic pole. A long-exposure photograph (200 minutes) taken with the 100-inch reflecting telescope at Mount Wilson "records fully as many recognizable nebulæ as stars" (Hubble). The farthest of these nebulæ recorded on the photograph are thought to be at an average distance of the order of 500 million light years. Thus in the general direction of the galactic poles—unobscured by the vast gas and dust clouds of our stellar system—we look out into remotest space.

Announcements

On medical advice, Sir Edwin Butler, formerly director of the Imperial Mycological Institute, has resigned from the secretaryship of the Agricultural Research Council.

Dr. Franz Verdoorn, editor of *Chronica Botanica*, has been appointed research associate in the Farlow Herbarium, Harvard University.

The Rockefeller Foundation has agreed to continue until the end of 1941 its grant of £1,200 a year for research in cellular physiology at the Molteno Institute, University of Cambridge, under the direction of Prof. D. Keilin.

In 1938 there were 15,111 cases of smallpox in the United States. Of these, 14,106 occurred in the States north of Ohio and west of Mississipi, where vaccination is not compulsory.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES. PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Action of Sulphonamides and their Derivatives on Bacteria

THE sulphonamides constitute a group of therapeutic agents of the highest importance in the treatment of disease, yet at the present time comparatively little is known concerning the precise nature of their mode of action upon micro-organisms in general. In this connexion Long and Bliss in their work "The Clinical and Experimental Use of Sulphanilamide, Sulphapyridine and Allied Compounds" quote: ". . . for the time being one must be content with the simple conception that these sulphonamido preparations inhibit the growth of susceptible micro-organisms in the body and in the test tube". In my investigations on the *in vitro* mode of action of sulphanilamide I have discovered a hitherto unknown yet easily demonstrable reaction which throws considerable light upon the mechanism of the anti-bacterial activity of this drug and renders it necessary to modify the above statement of Long and Bliss. In this preliminary communication I wish to place on record a brief summary of my researches during the last twelve months.

It is a well-known fact that the group of organisms exemplified by *B. subtilis, B. mycoides, B. megatherium, B. mesentericus* exhibit a pelliculous growth on the surface of the liquid culture medium. I have found that members of this group exhibit an abnormal behaviour in the presence of sulphanilamide and allied compounds of the sulphonamido type in as much as the pellicle formation is inhibited or completely suppressed. Concentrations of sulphanilamide of 1 : 100 to 1 : 3000 retard the rate of growth of *B. subtilis*, but even in the presence of this high concentration of the drug an excellent growth of the organisms develops after some time, although pellicle formation does not take place. In dilutions greater than 1 : 3000, sulphanilamide exerts no retarding influence on the rate of growth of the bacteria, but, in spite of the normal rate of growth, there is complete suppression of pellicle formation which persists down to dilutions of sulphanilamide as great as 1 : 50,000 to 1 : 100,000. As the dilution of the drug is increased beyond 1 : 100,000 there is observable a gradual development of pellicle. I have found, moreover, that the degree of inhibition of pellicle formation is strictly parallel with the degree of inhibition of spore formation. The inhibition and ultimate suppression of sporulation is indicative of a subnormal bacterial metabolism, and from this it must be inferred that the bacteria are living in an asthenic state. In addition, I have observed that the ability to inhibit and suppress pellicle formation is not limited to sulphanilamide alone, but is also possessed by a multitudinous number of diverse chemical compounds; in fact it is possessed in varying degree by all substances which exert an injurious effect upon the bacterial life.

Up to the present time it has been possible to demonstrate two types of anti-bacterial activity, namely, bactericidal and bacteristatic. However, it is now possible to extend this and render demonstrable in a precise yet simple manner a third state of anti-bacterial activity which I have designated a bacteriasthenicizing activity. Under the bacteriasthenicizing influence the bacterium exhibits a normal rate of growth but a subnormal metabolism, that is, the organism continues to live and grow in a state of bacteriasthenia.

It is a well-known fact that chemical change in the structure of the sulphanilamide molecule, such as the introduction of N_1 and N_4 substituents or modification of orientation of the amino and sulphonamido groups, changes in a precise and definite manner the *in vivo* anti-bacterial activity. By experimenting with all the well-known synthetics of the sulphonamido group I have found that in the same way alteration of the chemical structure of the sulphanilamide molecule is accompanied by a modification in the ability to inhibit pellicle formation of *B. subtilis* and, moreover, that this modification is strictly parallel with the modification of the *in vivo* anti-bacterial activity. This is demonstrated in the accompanying table.

Drug	*In vivo*	*B. subtilis* reaction
Sulphanilamide	Very active	Very active. Pellicle formation suppressed down to sulphanilamide concentration of 1 : 100,000
Sulphanilic acid	Slightly active	Slightly active. Pellicle formation suppressed only by concentrations of sulphanilic acid greater than 1 : 4000
N_4 acetyl-sulphanilamide	Inactive	Inactive. Good pellicle formation in concentrations of drug as high as 1 : 1000

All active compounds at present in therapeutic use, for example, sulphanilamide, albucid, sulphapyridine, soluseptazine, etc., are active in the new reaction, that is, they completely suppress pellicle formation down to dilutions of the drug of 1 : 50,000 to 1 : 100,000.

Moreover, it is a well-established fact that the anti-bacterial activity of sulphanilamide is inhibited by the presence of *p*-aminobenzoic acid both *in vitro* (Wood) and *in vivo* (Selbie). A parallel phenomenon is observable in the new reaction, namely, although high dilutions of sulphanilamide suppress pellicle formation, the addition of *p*-aminobenzoic acid enables copious pellicle formation to take place even in high concentrations of sulphanilamide.

The complete results of the researches outlined above, with results obtained *in vitro* in the presence of blood and serum, and together with observations on the bacteriasthenicizing activity of the blood and serum of patients undergoing sulphonamide therapy, will be shortly published.

M. Mandelbaum.

Ward, Blenkinsop and Co., Ltd.,
Research Laboratories,
London and Liverpool
(formerly Director, Bacteriological and
Serological Institute.
Hospital Munchen-Schwabing,
Munich). Jan. 28.

Vitamin Content of Salmon

The tables of the vitamin content of foods of Fixsen and Roscoe[1] are in constant use in assessing the vitamin value of diets. Our attention, however, has recently been directed particularly to salmon. The vitamin A concentration of body oil and flesh oil is there given as 4,400–52,500 and 0–20,480 international units per 100 gm., while the vitamin D concentration of flesh oil is listed as 9,500 international units per 100 gm., and the vitamin D content of salmon flesh at 200–800. The ascorbic acid content given is 89·9–215·6 mgm. per 100 gm. of flesh. These vitamin C figures are higher than any reported for oranges and lemons and equal those given for varieties of blackcurrant, noted for their antiscorbutic properties. Taken together with a calorific content thrice that of orange juice, these values suggested that salmon might be regarded as deserving of precedence over the citrus fruits for import space.

Confirmation of these figures was desirable. Since most of the salmon eaten in Great Britain is tinned, twelve different brands were purchased in the open market, together with a chilled salmon weighing about 24 lb. This was kept in a cold store until a few minutes before the analyses were made. The accompanying table shows the results of the analyses on these.

Sample.	Vitamin A (blue value).	Vitamin B (I.U. per 100 gm.).	Vitamin C (mgm. per 100 gm.).
1. Alaskan	nil	10	nil
2. ,,	,,	10	,,
3. ,,	,,	10	,,
4. English (probably)	,,	15	,,
5. ,, ,,	,,	11	,,
6. ,, ,,	,,	8	,,
7. ,, ,,	,,	11	,,
8. Scottish (probably)	,,	8	,,
9. ,, ,,	,,	8	,,
10. ,, ,,	,,	10	,,
11. 'Foreign'	,,	8	,,
12. Japanese	,,	8	,,
13. *Chilled Salmon.*			
a. Middle cut	nil	76	9
b. Tail cut	nil	86	9
c. Liver	860		10
d. Roe (hard)	30	190	21
e. Intestine	33	38	10
f. Pancreas	154	34	6
g. Heart			8
h. Gills	nil	nil	4

Vitamin A was determined by hydrolysis of the fish sample in methyl-alcoholic potash and measurement of the antimony trichloride 'blue value' calculated to a 20 per cent solution of the original sample on the non-saponifiable residue. No carotene was detected. Vitamin B_1 was determined by the thiochrome method; vitamin C by titration with 2·6 dichlorophenol indophenol.

A representative sample of the whole material from one of the tins listed above was assayed biologically on chicks by the B.S.I. standard radiographic-technique for vitamin D_3. It gave a figure of 600 units per 100 gm. of flesh with fiducial limits at $P = 0·95$ of 83–119 per cent. This agrees with Fixsen and Roscoe's figure quoted.

From this work, it appears that, although fresh salmon may contain the large vitamin stores attributed to it, the material that reaches the table of the British housewife is far from being as rich in vitamins A and C as hitherto published figures would suggest.

Magnus Pyke.
Margaret D. Wright.

Research Laboratories,
Vitamins, Ltd.,
London, W.6. Jan. 16.

[1] *Nutrition Abst. and Rev.*, 7, 823 (1937–38); 9, 795 (1939–40).

Weather, Wild Birds and Home-grown Food

The effects of the severity of the winter of many years back on wild birds have been described by various writers from 1408 onwards, but coming to more recent times we have the comprehensive account given by James Hardy and others[1] for the winter of 1879–80, that of A. W. Preston[2] for 1890–91 and other references to the winter of 1894–95. Still more recently we have the excellent account by Jourdain and Witherby[3] of the disastrous effects of the winter of 1894–95, and finally the very full and valuable account of the effects of the particularly severe winter of 1939–40 given by Ticehurst and Witherby[4].

It is unnecessary here to detail the enormous reductions that have taken place in our wild bird fauna. They are very serious and the repercussions will be of a far-reaching nature.

Those interested in economic biology know what an enormous amount of home-grown food was destroyed by injurious insects and rodents in 1917 and 1918, and there seems no reason for supposing that any but similar conditions will prevail in 1941 and 1942, unless some wise and well thought out action is taken quickly.

Writing in 1918[5] I have pointed out that "All who take an interest in the ways and habits of wild animal life must have been struck by this curious coincidence—namely, during the spring and summer of 1917, very many of our commoner species of wild birds were apparently rare, and injurious insects and rodents were particularly abundant; during 1918 the same phenomenon was still more noticeable, the insects being exceedingly abundant, in many districts sufficiently numerous to constitute a plague. As a result of this dislocation of the so-called balance of nature an enormous amount of home-grown food has been lost".

To-day it is not enough for the farmer and fruit grower to grow abundant crops if such cannot be harvested clean and free from disease. Every year vast quantities of such food are destroyed by injurious insects and rodents, and this year and next, owing to the great reduction in our wild bird population, that amount will increase to an enormous extent, and although we are increasing the acreage cultivated, the sum total, in very many cases, instead of being more, will be less.

In view of the seriousness of the situation, I suggest that the destruction or taking of any wild birds or their eggs in Great Britain and Northern Ireland from now until the end of 1942 (the following species excepted—house sparrow, starling and wood-pigeon) should be prohibited during 1941 and 1942, and the results of such action carefully reviewed and any further action considered at the end of 1942.

WALTER E. COLLINGE.

The Yorkshire Museum,
York. Jan. 21.

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[1] *Proc. Berwickshire Nat. Club*, 9, 304–572 (1881).

[2] *Trans. Norf. and Norw. Nat. Soc.*, 5, 191–195.

[3] *Brit. Birds*, 11, 266–271, and *ibid.*, 12, 26–35 (1918).

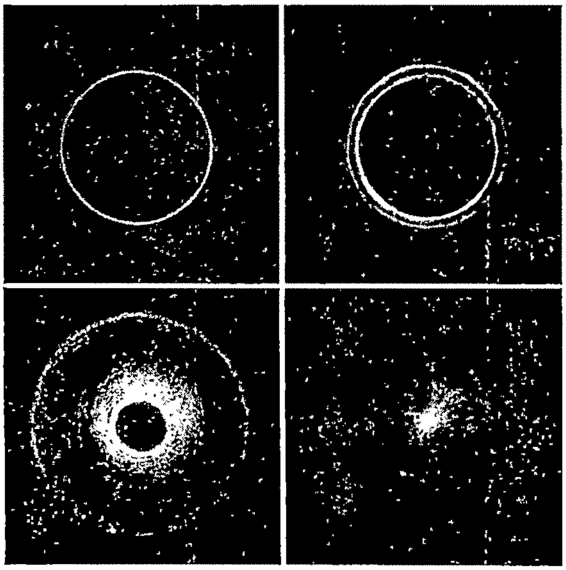
[4] *Brit. Birds*, 34, 118–132, and *ibid.*, 142–155 (1940).

[5] *National Review*, 234–239 (1918).

Conical Refraction in Naphthalene Crystals

THE birefringence of many organic crystals of the aromatic class is large, and when the intermediate index differs widely from the upper and lower indexes, the angles of internal and external conical refraction assume very high values. These angles in naphthalene, for example, are both about 13° 45′, which may be compared with 1° 54′ and 1° 44′ respectively in the classical case of aragonite. By fusion followed by very slow solidification, it is fairly easy to obtain transparent blocks of naphthalene and other aromatic compounds. When suitably cut and mounted between glass cover-slips, naphthalene crystals exhibit the phenomena of conical refraction in a very striking way, and enable their features to be critically examined.

The photographs reproduced with this note are the images of a fine illuminated pinhole held against the face of a naphthalene crystal 2 mm. thick and viewed through it in the appropriate direction. In the first of the series, the pinhole is seen in perfect focus and appears as a very sharp and perfect circle. The three other pictures illustrate the effect of moving the focus away from the pinhole, until, finally, in the last picture, the second surface of the crystal is in focus. The central bright spot seen in the fourth picture is actually an image[1] of the fine pinhole used, and appears at the point where the axis of single-ray velocity meets the rear surface. This bright spot continues to be the most conspicuous feature in the field for a great distance behind the crystal.


1 2 3 4

CONICAL REFRACTION IN NAPTHALENE CRYSTALS.

It will be seen on a comparison of the first and second pictures that, at least in the case of naphthalene, *the so-called Poggendorf dark circle vanishes when the pinhole is seen in perfect focus.*

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Dec. 19.

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[1] Raman, C. V., NATURE, 107, 747 (1921), and *Phil. Mag.*, 43, 510 (1922).

Temperature Dependence of Adiabatic Compressibility

IT is well known that the adiabatic compressibility β_φ of a liquid increases fairly rapidly with rise in temperature. The rise becomes more rapid as the temperature increases. With many liquids the adiabatic compressibility increases by about 60 per cent for a rise of temperature from 0° to 60°, or $\frac{1}{\sqrt{\beta_\varphi}}$ decreases by 21 per cent. A large part of the high initial compressibility of ordinary liquids is connected with the nearness of the critical point liquid gas, for compressibility in the gas phase is high and at the critical point itself compressibility is infinite[1]. Hence the absolute value of the compressibility depends on how far the temperature is from the critical point.

The characteristic frequency of vibration of molecules in a liquid is given by

$$\nu = S\left(\frac{3N}{4\pi V}\right)^{1/3},$$

where S is the velocity of sound in the liquid and N and V are Avogadro's number and molar volume respectively[2];

$$\text{or } \nu = c\sqrt{\frac{V^{1/3}}{M\beta_\varphi}},$$

for a given liquid, where c is a constant and M the molecular weight.

In the light of the available data[3] on the compressibility of a number of liquids, the above expression has been examined in relation to its temperature variation, and it is found that the expression decreases linearly with temperature according to the relation

$$\sqrt{\frac{V^{1/3}}{M\beta_\varphi}} = k\,(\theta_c - \theta),$$

where θ_c is the critical temperature, θ is any temperature and k is a constant characteristic of the liquid. In the following table are given values of k for a number of liquids:

Liquid	k
Benzene	110·8
Carbon tetrachloride ..	77·5
Ether	121·8
Chlorobenzene	80·8
Toluene	92·6
Acetic acid	93·6

The expression does not hold for alcohols. It is also found that a fair estimate of the critical temperature can be made from the variation of the adiabatic compressibility with temperature.

Details will be published elsewhere.

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Oct. 20.

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[1] Bridgman, *Rev. Mod. Phy.*, 7 (1935).

[2] Born and Karman, *Phys. Z.*, 14, 15 (1913).

[3] Tyrer, *J. Chem. Soc.*, 105, 2534 (1914).

Laws of Nuclear Structure Derived from Nuclear Spins

In 1935 and 1936 I directed attention[1] to a striking statistical property of atomic nuclear spins, namely, that the form of the distribution curve for spins of atoms with odd atomic weight depends upon whether the odd particle in the nucleus is a proton or a neutron. Since then, new and revised nuclear spin values have been reported for a number of atoms. The new distribution curves completely confirm the conclusions I then gave relating to the orbital and spin momenta of nuclear particles. Fig. 1 shows the new distribution for atoms with odd atomic number (odd nuclear proton) and Fig. 2 that for atoms with even atomic number (odd nuclear neutron). Shaded areas represent the number of atoms for which the reported spin values are doubtful but probable.

Nuclear spins are now known for eighteen pairs of isotopes in which both constituents have odd atomic weight. Eleven of these pairs (A) have odd atomic number (odd proton), the remaining seven pairs (B) having even atomic number (odd neutron). These isotope groups are :

GROUP A
Odd nuclear proton

Atom	Isotope	Spin
Cl	35 37	} 5/2
K	39 41	} 3/2
Cu	63 65	} 3/2
Ga	69 71	} 3/2
Br	79 81	} 3/2
Ag	107 109	} 1/2
Sb	121 123	} 5/2
Eu	151 153	} 5/2
Re	185 187	} 5/2
Tl	203 205	} 1/2
Rb	85 87	5/2 3/2

GROUP B
Odd nuclear neutron

Atom	Isotope	Spin
Mo	95 97	} 1/2
Cd	111 113	} 1/2
Sn	117 119	} 1/2
Ba	135 137	} 3/2
Xe	129 131	1/2 3/2
Yb	171 173	1/2 5/2
Hg	199 201	1/2 3/2

It will be noticed from these that there is another striking difference in distribution depending upon the nature of the odd particle. Apart from rubidium, *all* the members of group A have the *same* spin for both constituent isotopes. On the other hand, three out of the seven pairs in group B have *different* spins for the two isotopes, the heavier isotope having a greater spin. The exception, rubidium, is of particular interest, for the isotope 87 is radioactive and this is very likely to be the cause of the deviation.

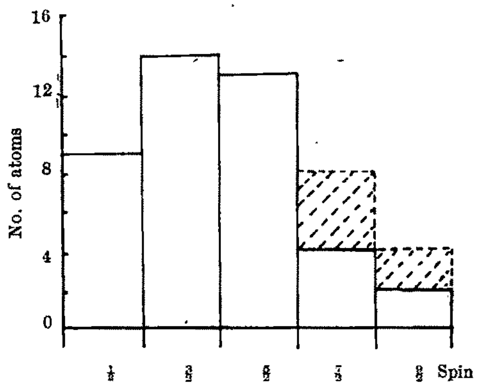

Fig. 1.
Odd proton.

In all these isotopic pairs the heavier constituent is formed from the lighter by the addition of a pair of neutrons. Both the curves and the additional data just given afford indirect support for Landé's odd particle theory of nuclear spin.

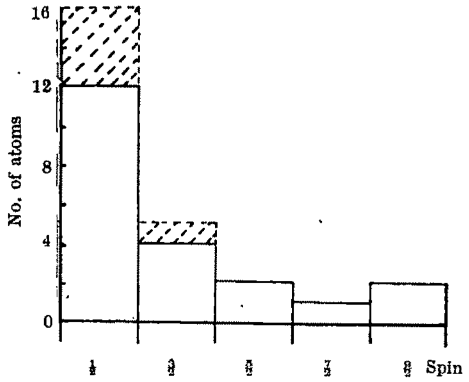

Fig. 2.
Odd neutron.

Three laws for nuclear structure can therefore be derived for stable odd atomic weight atoms :

(1) In stable atomic nuclei with an odd nuclear *neutron*, the spin and angular momenta of the lightly bound or odd particle(s) tend to *oppose* each other[1].

(2) In stable atomic nuclei with an odd nuclear *proton*, the addition of two neutrons does *not* alter the nuclear spin.

(3) In stable atomic nuclei with an odd nuclear *neutron*, the addition of two neutrons *may* increase the nuclear spin.

As a corollary to (2), it may be considered that when two neutrons are added in the presence of an odd proton, the neutrons set themselves with their spins in opposition.

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Jan. 6.

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[1] S. Tolansky, Nature, 137, 1071 (1936).

RESEARCH ITEMS

Bronze Head from Ifé, Nigeria

The British Museum has recently acquired through the good offices of the National Art Collections Fund an example of the remarkable realistic art of Ifé, Southern Nigeria, in the form of a bronze head. This region of Southern Nigeria, which has long been known as the religious and cultural centre of the Yoruba people, possesses an ancient tradition of artistic accomplishment of a high order. It is distinguished by its realism from the generality of Negro sculpture, which is better displayed in diverse simplifications and conventionalizations of the human form than in strict fidelity to Nature. Hitherto, Ifé art has been represented in the British Museum only by a single original in the form of a terra-cotta head. In recent years a number of examples of the bronze heads have been found during building operations at Ifé, while the late Leo Frobenius collected several of the terra-cottas in 1911–12. In describing the British Museum acquisition, H. J. Braunholtz (*Brit. Mus. Quarterly*, 14, 4; 1940) states it is of exceptional ethnographic and æsthetic interest. It has evidently been cast by the *cire perdue* process and is now patinated to a green tint, though showing traces of red paint on the headdress, possibly a relic of painting of the whole. Parallel lines on the face represent a form of scarification still practised. Small holes surrounding the mouth and extending to the ears presumably were intended for the insertion of hair or other material to represent a beard and moustache. In vitality and sensitive modelling, it bears comparison with the finest sculpture of other times and countries. In date it can scarcely be later than the sixteenth century, when the art of Benin reached its highest peak.

Reproduction of Trout in New Zealand

A wide collection of material from sixty-four streams in ten river systems in the North and South Islands has enabled Derisley F. Hobbs to reach reasonably sound conclusions regarding the natural reproduction of the introduced brown trout (*Salmo trutta*) and rainbow trout (*S. irideus*) in New Zealand (*Fisheries Bull.*, No. 8, New Zealand Marine Dept., Wellington: Gov. Printer, 1940. 3*s*.). The conditions required by trout for spawning are very special, and are to be found in restricted areas even in streams with beds predominantly of gravel. The result is that all the suitable sites are used for redds by early spawners, and late spawners, rather than spawn in unsatisfactory materials, make use of already occupied sites. Mortality therefore arises from the actual displacement of the earlier eggs, or from the deposition of silt upon the earlier eggs by the later activities, for heavy losses in redds were found to be associated with the presence of excessive quantities of fine silty matter. The extent of losses caused by superposition of redds has not been measured, but apart from that, losses are extremely small in the majority of redds. Deaths before hatching vary from 3·20 to 12·86 per cent, with one extreme case of 29·29 per cent. Between the time of hatching and the emergence of the fry from the redds, the death-rate is exceedingly low; in only one of nine river systems did it exceed 1 per cent. The author discusses in a hypothetical way the question of optimum density and exploitable excess in these natural populations; but the validity from the practical point of view of the angler or fish conservator of such conclusions as he reaches is likely to be overshadowed by natural fluctuations and environmental influences generally.

Flight of an Insect

Under the title of "The Flight of a Dipterous Fly *Muscina stabulans* Fallen", F. S. G. Hollick of the Zoological Laboratory, Cambridge, describes the results of his investigations (*Phil. Trans. Roy. Soc.*, B, **230**; 1940). As a preliminary, a comparison was made between the flight system with the insect held stationary and in normal free flight, and the relationship of one to the other established. The resultant of those forces, which by action on the insect's body maintain or change its state of motion during flight, was taken as the criterion for comparison. The author exposed the insect, held stationary, to a stream of air in a wind tunnel and states that there are good grounds for believing that such a method is suitable for the further study of flight. By recording photographically the amplitude of the wing-beat for ten individuals inclined at 0°–45° to air flows ranging from 0 to 320 cm. per second, it was shown that the amplitude decreased with increasing air speed and inclination of the body axis. A study of the path travelled by the wing relative to the insect shows that when the insect is exposed to a stream of air the course of the downward beat is displaced forwards, so as to convert the elliptical track characteristic of wing movement in 'still air', into the figure of eight path, commonly associated with insect flight. This change of path traversed by the wings was found to be dependent upon the movement or position of the third antennal joint relative to the second joint, resulting from the action of the stream of air on the third joint and the arista. The usual flight attitude of the legs and the continued maintenance of wing vibrations when air was blown on the insect from in front, were also found to be dependent upon the integrity of this system. In the appendixes the author describes his method of mounting living insects for experiment, together with the design of an aerodynamic balance and that of a small wind tunnel.

Caytonia: A Gymnosperm

T. M. Harris has redescribed the fruits of Caytonia from the material in the Wonnacott Collection in the British Museum (*Ann. Bot.*, N.S. **4**, October 1940). As a result, *Gristhorpia nathorsti* is renamed *Caytonia Gristhorpi*, and further support is given for associating all three species of Caytonia with foliage of species of Sagenopteris. In his original account, Hamshaw Thomas described the fruits as curved structures terminating in a lip on the adaxial side, which was termed a stigma. Harris has now found pollen in the micropyles of fifteen specimens of *C. sewardi* and sixteen of *C. nathorsti*, and concludes that the lip in life must have bordered a slit through which the pollen could enter the structure, so that the pollination was definitely gymnospermous in character. This necessitates a mechanism by which the pollen is directed from the lip to the micropyle, particularly as pollen is not found freely in the cavity of the fruit. The state of preservation makes the solution of this problem difficult, but Harris points out that the peculiar barred structure of the mouth may result from the obliteration of converging canals running from the ovules to the mouth, and along which some 'pollination drop' mechanism may have conveyed the pollen. Harris concludes that Caytonia is a megasporophyll with pinnate branching, the pinnæ bearing ovules on their uncurved adaxial surfaces. This coincides with Thomas's first analysis of the structure: the later attempts to homologize the megasporophyll segments with carpels, or with the 'cupules' of the Corystospermaceæ, are deprecated.

Cross-lamination in Sandstones

A STUDY based on statistical analysis of cross-lamination in four Palæozoic sandstone units in northern Arizona—one of marine, two of deltaic and one of æolian origin—has been made by E. D. McKee, whose results are now published (*Amer. J. Sci.*, 238, 811–824; 1940). In the Tapeats sandstone (Lower Cambrian marine) the type of cross-lamination pattern consists of repeated layers, each containing series of short, uniformly sloping, laminæ truncated by flat surfaces above and below, and suggests a sinking basin in front of a delta. In the Supai formations (Permian deltaic) the beds are characterized by a series of sloping, even, lamination surfaces which dip uniformly from top almost to bottom, suggesting development on the advancing fronts of small local deltas. Comparable structures have been observed by the author over large areas of the present-day Colorado River delta. In the upper Supai sediments individual sets of sloping laminæ terminate laterally by interference from other sets and the resulting patterns resemble 'compound foreset bedding' due to interference of adjacent lobes. In the Conconino sandstone (Permian æolian) the structure consists of sloping truncated wedges and is devoid of flat-lying or horizontal layers such as characterize the formations mentioned above. Moreover, the maximum dip (33°) is higher than that of the others, and some of the low-angle slopes show a direction reverse to the normal, indicating depositional or erosion surfaces on the windward side of the dunes. The data collected also serve to determine the different directions of transportation among the various types of sediments considered.

Fermentation of Ceylon Tea

THE term 'fermentation' is understood in the tea industry to mean the enzymic process during which 'black tea' develops its aroma and colour. After harvesting, the partly dried leaf is broken up in a rolling machine, whereby some of the juices are worked out from the leaf and form a varnish-like coating on the surface. This rolling or crushing starts fermentation which may be allowed to continue for several hours. The initial green colour of the crushed leaf changes during this time to a coppery-red tint. The tea is then dried, cleaned and graded. It has been known for some time that this fermentation involves oxidation of polyphenols in which oxidases, peroxidases and catalases are concerned. The substrates include tannins, catechins and polyphenols (catechol, gallic acid) so that the whole process is very complex. Since tea leaf contains a much higher amount of polyphenolic substances than is usual in plant tissues, it would not be surprising if it contained also enzyme systems with rather specialized functions. J. Lamb and H. B. Sreerangacher (*Biochem. J.*, 34, 1472; 1940) now show that tea leaf preparations show marked specificity in the oxidation of ortho-dihydric polyphenols, without the activation of peroxidase, the primary oxidation products being probably orthoquinones. The system possesses the power of forming aniloquinones in the presence of quantities of potassium cyanide which are known to inhibit peroxidase activity. The system may be a parallel to the ascorbic acid - ascorbic oxidase and the cytochrome C - cytochrome oxidase systems in other plants, where a specific oxidase catalyses the initial changes of a series of reactions.

X-rays and Enzymes

IT has usually been thought that X- and γ-rays only influence enzymes when the dose is enormous, that cell division is inhibited by doses which have little or no destructive action on enzymes, and that, therefore, this inhibition is produced by a process in which enzymes play no important part. It has recently been found by W. M. Dale (*Biochem. J.*, 34, 1367; 1940) that purified carboxypeptidase and polyphenoloxidase in low concentration are indeed affected by radiation in small doses. The percentage inactivation of these enzymes is a function of the enzyme for a given dose of radiation. Absorption of a definite amount of radiation energy corresponds to a constant amount of enzyme inactivated. Inactivation of carboxypeptidase does not take place when the enzyme is acting on its substrate during irradiation, whereas the enzyme irradiated without its substrate is inactivated to 85 per cent. This, if it can be generalized, furnishes an explanation of the so-called delayed action of X-rays in the sense that the reserves of unused enzyme in the cell are inactivated by radiation, whereas that part of the enzyme already in action remains unaffected by radiation.

Structure of Multilayers

X-RAY and microscopic examinations of multilayers of some long-chain esters have been made by G. Knott, J. H. Schulman and A. F. Wells (*Proc. Roy. Soc.*, A, 176, 534–42; 1940). In order that microscopic examination could be made by transmitted light, the deposits were made on transparent bases such as celluloid, cellulose acetate, 'Perspex', 'Polystyrene', 'Formvar', vinyl acetates and other synthetic resins. Between crossed nicols, the individual crystals extinguished perfectly, showing that the molecules are arranged in some regular way from the base of the multilayer to the surface. The grain boundaries seen on the surface are therefore those of single crystals which have grown without interruption through the entire thickness of the multilayer. The same type of X-ray photograph was got from a stationary multilayer of ethyl stearate as from a single crystal of β-ethyl stearate rotated about the long axis of the cell. The 'spots' observed on oscillation photographs of multilayers of ethyl stearate taken in earlier work proved to be parts of circles, successive arcs of which appear on increasing the angle of incidence of the X-ray beam on the multilayer. It is concluded that the multilayers consist of microcrystals all oriented with a common axis normal to the surface. The single crystals were about 1,000 molecules thick in this investigation.

SOCIOLOGICAL ASPECTS OF EVACUATION

THE cross-section of our social life revealed in the stimulating and instructive report* of Mr. Geoffrey Shakespeare's committee on conditions in reception areas, does more than give a clear picture of the problems arising out of a sudden and extensive redistribution of the population and of the possibilities for good and ill innate in that process. It shows convincingly the way in which evacuation and education are linked with many other phases of our war-effort and with plans for reconstruction after the War. Again and again the efficiency of our war-effort in some particular field is powerfully affected by conditions in an apparently remote field. Adoption of many of the Committee's admirable suggestions is accordingly as much to be desired from the point of view of war-production or reconstruction as from that of educational or social welfare, and it is satisfactory to learn that most of them are being acted upon by the Ministry of Health.

A pertinent example is to be found in the matter of billeting. Much trouble is caused by the conflict between civilian and military billeting, and the report insists that there should be closer co-operation between all branches of the services and with the regional authorities. Periodical conferences between all billeting and quartering authorities and representatives of the Ministry of Labour are recommended. If the agreements reached are broken or points of dispute arise, the question should be referred for settlement by the regional commissioner and the senior military or air force officer in the region concerned.

It should not be forgotten, moreover, that this question of billeting impinges on that of man-power and production. The dispersal of factories on war-production, no less than the training of new labour and increasing the mobility of workers, particularly the skilled workers essential to the development of our full effort in production, will in itself make demands for billeting which must be co-ordinated with those arising out of evacuation, military or air force needs, if competiton and undesirable stresses and strains are not to occur. Furthermore, it may be necessary in some areas to exercise the Government's powers not merely to ensure that there is no evasion by well-to-do persons in the provision of billets, but also to see that unofficial and uncontrolled immigration into a reception area by those unable or unwilling to play their part in the national effort does not impede national and official schemes. Such instances may be rare, but failure to deal with them firmly can have far-reaching consequences.

An allied matter is the requisitioning of premises. Here, again, there is need for fuller co-operation. Adequate welfare arrangements depend on the availability of suitable premises, and while amenities for soldiers are very desirable, it is not right that all suitable premises should be so used to the detriment of evacuees. This, the report suggests, is not a matter always to be achieved locally, and to liberate premises for welfare purposes regular conferences between the regional commissioners and the service liaison officers are recommended. There are also complaints that many large houses have been earmarked by Government departments but are not being used, and a review of those not in use is also recommended. More drastic use of the powers of requisitioning by the Ministry of Health is recommended, particularly in regard to requisitioning of parts of occupied houses for welfare or other purposes, as well as fuller co-operation by educational authorities in the use of school premises for welfare purposes, both after school hours each day and during the week-ends.

The report displays an admirable grasp of all sides of the problem, and it emphasizes the importance of easing the burden of billeting in the reception areas, to secure which is one of the purposes of its recommendation for more drastic use of requisitioning powers by the Ministry of Health. More often than not, billeting officers have difficulty in placing new arrivals at once, and the provision of a larger number of buffer hostels is recommended for new arrivals as well as those who for any reason desire to change or should change their billet, and also to relieve the burden falling on householders. The desirability of such hostels is only one of many reasons why the best and fullest use should be made of all accommodation. The report visualizes the application of requisitioning powers in particular to parts of occupied houses, and even to stored furniture required for equipping homes or hostels.

There is, however, yet another way in which the growing demands for man-power and woman-power enhance the importance of the wisest use of available accommodation, and of the pooling of equipment, as well as accommodation, that are involved in this vast redistribution of the population. The increasing shortage of domestic labour and the insistent call for women to enter industry, as well as to leave their homes and join one of the auxiliary services of the forces or assist in the myriad activities organized by the Women's Voluntary Service, make it increasingly difficult for some housewives to respond to the demand for private billeting. The situations which will arise may well require careful handling if the development of our war effort is not to be impeded, or the door opened to what in war-time can only be described as evasion or malingering.

Much stress is laid in the report upon welfare. The provision of communal welfare services is regarded as the essence of success. Specific recommendations include the provision of mothers' clubs with communal feeding, nursery centres, arrangements for occupation for mothers, communal bath houses and laundry facilities, and week-end hostels where husbands can stay when visiting their wives. Attention to such matters has already proved a brilliant success in certain areas; but the execution of this policy involves the immediate appointment of a large number of welfare officers to encourage and supervise the formation of such facilities. In particular, the appointment of more welfare officers who understand the psychology of London mothers is required.

The provision of such welfare officers is probably one of the major difficulties. The report itself refers to a shortage of women of a suitable type for appointment as welfare officers, and with the simultaneous and growing demand from industry for welfare workers, largely stimulated by the Minister of Labour and National Service, it is difficult to see where the supply is to be obtained. Here, indeed, may be a matter in which the National Register might be utilized with advantage and a scheme of co-operation or control in making the appointments may well be essential, especially when it is remembered that welfare work is assuming increasing importance in the sphere of civil defence. The necessity for an examination and comb-out in the women's services if we are to make full use of trained personnel was well shown in the examples cited by Miss Ward in her speech in the debate on Production, Supply and Man-power in the House of Commons on January 21.

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* Report on Conditions in Reception Areas. By a Committee under the Chairmanship of Mr. Geoffrey Shakespeare, M.P. Pp. 18. (London: H.M. Stationery Office, 1941). 3*d*. net.

Once again the report makes plain the inherent possibilities which may emerge from the complications caused by this redistribution of population, and its references to these possibilities are among the most interesting parts of the report. Country life is proving of the greatest value to the bodies and minds of town children, and it may be hoped that the new understanding of the country, and surprising interest in all rural pursuits may be shared by their parents sufficiently to help to secure a more balanced national economy. The new amenities and departures in social welfare now being established in the reception areas may have their own influence in arresting the drift from the country to the town if the nation can continue such experiments after the war.

If such hopes are to be realized, there must, indeed, be a fuller understanding by the countryman or woman and the townsman or woman of each other's sentiments, habits and outlook, the absence of which did much to wreck the evacuation scheme in 1939. While the Committee seems surprisingly satisfied with the success of the subsequent evacuation, it is clear that a large number of the evacuees have settled down happily in the reception areas, and that in the great majority of cases the experiment is succeeding, particularly with the unaccompanied children. The extent of the migration is sufficiently indicated by the 25 per cent increase in the population of the reception areas visited by the Committee during the first year of the War, exclusive of the large number of service personnel stationed in them, in contrast with a decline of more than 10 per cent in the year before the War. Two-thirds of this increase has been due to unorganized evacuation—the arrival, without notice, of more than a million people, many of the priority groups, who have since been billeted—and in the face of these figures the amount of confusion and friction, both of which are diminishing, is surprisingly small.

The mingling of town and country, the engendering of mutual understanding, of goodwill and good behaviour on both sides, encouraged as they have been by the ordeals of the last nine months, may well prove a solid asset when the need for evacuation is past. The suggestions and recommendations of the Committee, based on the experience gained, are designed to diminish the strains or friction set up and to promote fuller understanding as well as morale. They are not, indeed, novel. Many of the remedies have been frequently urged unofficially before—for example, in the reports of the evacuation committee of the Association of Architects, Surveyors and Technical Assistants, and of the Department of Social Science of the University of Liverpool.

Their official reiteration is none the less useful on that account, and has already had effect in regard to co-ordination in billeting and in the steps already taken to stop the dispatch of official parties to areas believed to be saturated, a position which has been reached already in certain districts more readily accessible from London.

The recommendations in regard to the immediate adaptation of emergency premises earmarked for the treatment of epidemics and the greater provision of premises for infectious diseases, for the wider extension of the district medical service and for the extension of the voluntary hospitals contributory scheme, where possible, to evacuees in the reception areas, are equally important. So, too, is the recommendation that careful watch should be kept on water-supply, sanitation and sewage disposal, where the influx of population has proved their inadequacy. Still more significant, however, is the reliance placed by the Committee on the regional machinery for giving effect to its recommendations. A wider use of regional powers originally, instead of giving large and drastic powers to the local authorities, which they were reluctant to use, might have avoided much unnecessary friction. The whole trend of the report in this respect is an answer to the severest criticism of evacuation contained in the Evacuation Survey report to the Fabian Society, edited by R. Padley and Margaret Cole, and it may well prove that adoption of the Committee's recommendations will give a further impulse to regionalism in Great Britain, and the handling of social problems on regional rather than local lines.

GRAVITY ANOMALIES AND THE EARTH'S FIGURE

THE literature on this subject is so voluminous and scattered, in many cases in periodicals that are not easily accessible, that a publication such as that by B. L. Gulatee*, which provides an introduction to the fundamental problems, with special reference to investigations developed in recent years and to practical applications, is likely to be welcomed by a wide circle of readers. Chapter i deals with the various gravity formulæ and gives brief proofs. The practical derivation of the empirical formulæ is reviewed in Chapter ii. Gravity observations and arc measurements show that a triaxial ellipsoid fits the geoid better than a spheroid; but it is pointed out that the ellipticity of the geoidal equator is not yet indisputably proved. The observations have been made only on limited portions of the globe, and until more gravity determinations are made in suitable areas the question will remain open.

Chapter iii gives an account of Clairaut's, Darwin's and de Sitter's theories of the figure of the earth. Certain objections are pointed out and reference is made to the more recent work of Jeffreys, in which he draws inferences from the moon's motion and so avoids the necessity of making any hypothesis about the internal state of the earth. In Chapter iv, which deals with gravity anomalies, a useful summary is given illustrating the application of such anomalies to the elucidation of the geological structure and history of those regions where they have been specially studied.

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* Gravity Anomalies and the Figure of the Earth. By B. L. Gulatee. Pp. viii+116+10 figs. (Survey of India, Prof. Pap. 30, Dehra Dun, 1940.) R.3 or 5s. net.

No matter what hypothesis of compensation is adopted, considerable anomalies persist in certain regions, examples of which are Peninsular India, the Ferghana Basin, Japan, the Dutch East Indies, the Caucasus, the Caribbean Sea, many oceanic deeps and islands, and the African Rift Valleys.

Regions of large positive anomalies, being areas of overload, should be expected to be continuously sinking. A notable exception is provided by the island of Cyprus, which has risen, despite its positive anomalies. Such evidence, like that of the 'negative belt' around the Dutch East Indies, provides evidence of phenomena going on inside or below the earth's crust. Another application of gravity anomalies is the derivation of the form of the geoid; this is discussed in Chapter v. Finally, in Chapter vi, the various types of reference surfaces are defined and it is shown that it is necessary to distinguish a triangulation reference spheroid from one based on gravity measurements.

For convenience the diagrams have been placed all together at the end of the book on two double pages, so that they can be opened and seen clear of the text. A list of symbols is given for easy reference. If a second edition be called for, as seems likely, it might usefully be provided with an index.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, March 3

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Dr. N. A. Mackintosh: "The Last Cruise of R.R.S. *Discovery II*".

Tuesday, March 4

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Prof. H. A. R. Gibb: "Egypt".*

Thursday, March 6

LINNEAN SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—General Meeting.

Saturday, March 8

GEOLOGISTS' ASSOCIATION (at the Imperial College of Science and Technology, Prince Consort Road, London, S.W.7), at 3 p.m.—Annual General Meeting. Mr. W. P. D. Stebbing: "The Early Use of Subsoils in Farming, and the Farmer and his Instructors before William Smith".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

CHIEF ASSISTANT FOR HIGHER EDUCATION—The Director of Education, Town Hall, Bradford (endorsed 'Chief Assistant for Higher Education') (March 7).

LECTURER IN MECHANICAL ENGINEERING—The Principal, College of Technology and Commerce, Leicester (March 8).

HEADMASTER of the Sunderland Junior Technical School—The Director of Education, Education Offices, 15 John Street, Sunderland (March 10).

CIVIL ENGINEERING ASSISTANT to the River Ouse (Yorks.) Catchment Board—The Clerk to the River Ouse Catchment Board, 7 Langcliffe Avenue, Harrogate (endorsed 'Engineering Assistant') (March 10).

REGISTRAR of University College, Southampton—The Registrar, University College, Southampton (March 18).

HEAD OF THE SCHOOL OF TEXTILES—The Principal, College of Technology and Commerce, Leicester (March 24).

TENNENT PROFESSOR OF OPHTHALMOLOGY—The Acting Secretary of University Court, University, Glasgow (May 1).

GRADUATE IN ENGINEERING SUBJECTS—The Principal, Dursley Technical Institute, Dursley, Glos.

LECTURER IN THE MECHANICAL ENGINEERING DEPARTMENT—The Clerk to the Governors, Technical College, Chesterfield.

ASSISTANT ENGINEER for the Malayan Public Works Service—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9306).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

John Innes Leaflet No. 4: The Fertility Rules in Fruit Planting. Pp. 8. (London: John Innes Horticultural Institution.) 6*d*. [161

Hull Museum Publications. No. 207: Excavations at Elmswell, East Yorkshire, 1938. By Philip Corder. Pp. 62+4 plates. No. 208: Saxon Relics from Barton, Lincs., and from Elloughton, E. Yorks. By Thomas Sheppard. Pp. 26. No. 209: A Panel of Celtic Ornament from Elmswell, East Yorkshire. By Philip Corder and C. F. C. Hawkes. Pp. 22+4 plates. No. 210: Early Tramcars and Record of Additions. By Thomas Sheppard. Pp. 38. No. 211: Yorkshire Neolithic Implements. By T. Sheppard. Pp. 24+11 plates. (Hull: Hull Museum.) [161

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 31: Salmon of the Ballisodare River, 1: History of the Ballisodare Fishery. By Arthur E. J. Went. Pp. 289–306+plate 7. 2*s*. 6*d*. Vol. 22 (N.S.), No. 35: Salmon of the Ballisodare River, 2: Age and Growth. By Arthur E. J. Went. Pp. 327–344. 2*s*. 6*d*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [201

Imperial Bureau of Soil Science. Technical Communication No. 40: The Rothamsted Field Experiments on the Growth of Wheat. By Sir E. J. Russell and D. J. Watson. Pp. xi+164+3 plates. (Harpenden: Imperial Bureau of Soil Science.) 7*s*. 6*d*. [291

Manchester Museum: University of Manchester. Museum Publication 117: Report of the Museum Committee for the Year 1939–40. Pp. 28. (Manchester: Manchester Museum.) 6*d*. net. [291

The Research Association of British Rubber Manufacturers. Pp. 16. (Croydon: Research Association of British Rubber Manufacturers.) [291

Other Countries

Southern Rhodesia Geological Survey. Short Report No. 33. Geological Report on the Manesi Gold Belt. By B. Lightfoot. Pp: 7+1 map. (Salisbury: Geological Survey.) [91

Dominion of Canada: Department of Transport, Air Services Branch: Division of Meteorological Services of Canada. Canadian Polar Year Expeditions, 1932–33. Meteorology: Cape Hope's Advance, Chesterfield Inlet, Coppermine, Meanook. Vol. 1. Pp. xvi+443+46 plates. (Ottawa: Government Printer.) [91

Tanganyika Territory: Department of Lands and Mines, Geological Division. Bulletin No. 14: Mica in Tanganyika. By Dr. G. J. Williams and A. F. Skerl. Pp. 52+7 plates. (Dar es Salaam: Government Printer.) 3*s*. [1912

Indian Forest Records (New Series). Entomology, Vol. 6, No. 4. Entomological Investigations on the Spike Disease of Sandal (35) Further Studies on the Spike Disease of Sandal. By Rao Sahib S. Rangaswami and A. L. Griffith. Pp. vi+85–196+12 plates. (New Delhi: Manager of Publications.) 4·4 rupees; 6*s*. 9*d*. [2412

Union of South Africa: Department of Mines: Geological Survey. The Geology of the Country around Potchefstroom and Klerksdorp. An Explanation of Sheet No. 61 (Potchefstroom) by Dr. Louis T. Nel, Dr. F. C. Truter and Dr. J. Willemse, incorporating previous Observations by Dr. E. T. Mellor. Pp. 132. (Pretoria: Government Printer.) 5*s*., including Map. [161

U.S. Department of Agriculture. Technical Bulletin No. 728: Parasites of the Oriental Fruit Moth in Japan and Chosen and their Introduction into the United States. By G. J. Haeussler. Pp. 62. (Washington, D.C.: Government Printing Office.) 10 cents. [201

Smithsonian Miscellaneous Collections. Vol. 99, No. 15: Evidence of Early Indian Occupancy near the Peaks of Otter, Bedford County, Virginia. By David I. Bushnell, Jr. (Publication 3601.) Pp. ii+14+5 plates. Vol. 99, No. 16: New Fossil Lizards from the Upper Cretaceous of Utah. By Charles W. Gilmore. (Publication 3602.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.) [231

Journal of the Faculty of Science, Imperial University of Tokyo, Section 2: Mathematics, Astronomy, Physics, Chemistry. Vol. 4, Part 2: Über die Struktur der l-Klassengruppe zyklischer Zahlkörper vom Primzahlgrad l. Von Eizi Inaba. Pp. 61–116. 1.10 yen. Section 3: Botany. Vol. 5, Part 4: The Genus *Hosta*. By Fumio Maekawa. Pp. 317–426. 3.60 yen. (Tokyo: Maruzen Co., Ltd.) [231

Department of Science and Agriculture, Jamaica. Bulletin No. 19: Fertilizer Investigations with the Gros Michel Banana. By H. H. Croucher and W. K. Mitchell. Pp. 30+10 plates. 6*d*. Bulletin No: 22: Report on the Coconut Growing Areas of Jamaica. By F. M. Bain. Pp. 12. 6*d*. Bulletin No. 23: A Survey of the Yields of Sugar Cane in Jamaica, 1938–1939. Report by R. F. Innes. Pp. 40. 6*d*. Bulletin No. 24: A Survey of the Yields of Sugar Cane in Jamaica, 1937–1938. Report by H. H. Croucher. Pp. 30. 6*d*. (Kingston: Government Printing Office.) [291

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SCIENCE, POLITICS AND GOVERNMENT

THE multitudinous ways in which science and its applications impinge on everyday life are apparent, as never before, to every thinking man. That it has required a major disaster in the form of a world war to bring about this realization is not to the credit of civilized people, but the fact should be faced that there is now widespread appreciation of the use—and misuse—which is being made of scientific knowledge. On the credit side must be placed the advances made in medical science as the result of the discovery of new treatments and new synthetic drugs, and the steps which are now being confidently taken to meet the nutritional needs of the nation in the absence of foodstuffs hitherto mainly imported from abroad, quite apart from the general rise in standard of living and increase of amenities to which we have grown accustomed in happier times. On the debit side there is the whole range of horror provided by modern warfare, based on scientific and engineering developments utilized for the destruction of man.

While this much will readily be conceded, there is not so general a concensus of opinion as to the part which science should take in the reconstruction and re-ordering of the world which will follow the end of the War. Correspondence which has been published in NATURE makes this point clear, and the differences of opinion are not only between scientific worker and layman but also among scientific workers themselves. One school of thought believes that science should be a discipline apart from worldly affairs, a disinterested pursuit of truth. Thus Prof. M. Polanyi has protested against a remark in an article in these columns to the effect that science can no longer be regarded as possessing "a peculiar holiness" setting it apart from other social interests. He has been answered by Dr. C. H. Waddington, who puts the case for utilizing scientific method over a wider field than that in which it now functions. Mr. R. H. F. Finlay has pointed to the success attained by chemical and engineering enterprises guided by scientific methods, and asks that science should take control in aspects of government in which it is competent. Dr. V. B. Wigglesworth interprets this as a suggestion that science should actually govern ; he asks if that would not be a definite threat to the freedom of scientific research, and states his belief that "the function of science in the national economy . . . is advisory". Elsewhere in this issue (pp. 298, 299), Dr. O. Blüh gives his views on reactions to planning in Central Europe during the past decade, and Dr. E. C. Childs points out some of the difficulties of applying experimental methods in this field.

This great diversity of opinion is evidence that the problem of the relation of science to society is still very much to the fore. It must be approached in a scientific manner ; in other words, the data should be gathered, deductions made and tested for consistency and when necessary scrapped, before action is taken. Admittedly, this is no easy task. Scientific men are but human, subject to prejudices like other men, though their training should enable them to recognize more readily when prejudice steps in and reason is put aside.

The fundamental point on which all can agree is that science represents the search for truth, for ever-increasing knowledge of the universe. It is inconceivable that this continuous probing of the secrets of Nature can ever be suppressed, even although circumstances may force it into the background for a while. In due time, some of the facts collected in this way come to have a direct influence on the lives of men, and in this way progressive civilization has been built up. We have now reached a stage when the contribution of science to everyday life has become a major one.

But in arriving at the present position, the conditions under which scientific research goes on have changed radically. The days of the natural philosopher pursuing his leisurely inquiries, perhaps alone, perhaps with one or two chosen disciples, have gone. Modern investigations are carried out for the most part in well-equipped laboratories attached to universities or large industrial concerns, while field-work often involves substantial expeditions. Although important discoveries are still made by the individual working with the minimum of apparatus, this method has become the exception. The tempo of research has increased and with this acceleration has come the team of investigators working together on different aspects of the same or allied problems.

Thus research has become to a large extent conditional on financial support, which has come in increasing amounts in recent years from State resources. As the fruits of scientific discovery in the long run lead to a higher standard of living and are of service to the nation as a whole, it is right that the State should contribute funds for this purpose; but this must not be allowed to endanger the freedom of the man of science to seek and to teach the truth. The administrative body can retain general control without allowing political, racial or religious views to influence the course of investigations or to falsify their results. The best method of exerting such control is still an open question, but it is fairly obvious that representative scientific bodies should take a prominent part. An experiment in this direction was the appointment last year of the Scientific Advisory Committee, which reports directly to the War Cabinet. This body, consisting of officers of the Royal Society and of the State research departments, is, of course, a war-time expedient, but it represents the kind of directing influence which should always be present in the Government, not only to formulate policy on the provision of funds for research, but, even more important, to deal with those numerous problems in which science impinges on human welfare both in war-time and in times of peace. Politicians may have special training and aptitude in the art of government, but they cannot be expected to appreciate in full measure the significance of scientific developments, or to foresee the course of events where the application of scientific knowledge is concerned. Here, then, science should have a place in the government of the country—not to deal with affairs of which it can claim no special knowledge, but with those in which it is particularly competent. It remains for the future to decide the precise manner in which science should be represented in the Government.

Closely entwined in the arguments for and against the participation of science in public affairs, are frequent references to the social responsibilities of science and scientific men. This theme has been discussed many times in these columns. In brief, it comes to this: the scientific worker must seek after truth, but he should not be saddled with the whole responsibility for the misuse often made of it by others. Nevertheless, he should, through his own organizations and individually, press for such appreciation of the true worth of science as would prevent its misuse. It may be argued that it is too much to expect to eliminate the individual, or the State, which would endeavour to exploit discoveries selfishly or without regard for the welfare of mankind, but at least the attempt would be worth while, and it would bring nearer the day when such an individual or State would be outlawed by mankind.

It is perhaps in this wider field of international affairs, paradoxically enough, that the influence of science has produced its most tangible effect. As Prof. A. V. Hill showed in his recent address to the Parliamentary and Scientific Committee (see NATURE, March 1, p. 250), international congresses for the discussion of progress in various fields of scientific endeavour have been effective instruments in promoting progress and understanding. Further, as has frequently been emphasized in these columns, the achievements of the scientific and technical services of the League of Nations have marked a noteworthy stage in international collaboration.

Scientific men, working in their own fields, have given a wide significance to the phrase 'science and society'. They have shown that they can rise above political considerations in affairs of the State and internationally, to the lasting benefit of humanity. 'Science' has, indeed, become inseparable from 'society'; one is dependent on the other. On the part which is played by science—using the word in its widest sense and including the inquiring and unprejudiced approach which should be characteristic of scientific investigation—in determining world conditions after the end of the War will depend the stability of international affairs by which alone civilization can flourish.

INTERNATIONAL CULTURAL RELATIONSHIPS

THE concentration which all the sources of publicity during a period of crisis must give to the War tends to diminish proper and adequate comment upon other activities within the country. It may be for this reason that but little notice has been taken of a remarkable document entitled "Greece No. 1 (1941) Convention between His Majesty in respect of the United Kingdom and His Majesty the King of the Hellenes respecting the Relations of Learning and Culture between Great Britain and Greece"*. Yet this Treaty should not go unregarded, for it marks a notable development in British relationships with foreign countries. It is a Treaty not of war and peace, nor of commercial bargaining; it is uncontaminated with the breath of propaganda; it is an attempt in an honest and unequivocal way to develop the relationships of thought and mind, of literature and science, between two great civilized peoples.

There is a dramatic propriety in the fact that the first Treaty of this kind to which Great Britain has given her signature should be with Greece. The contact of British civilization with that of Greece extends for centuries, and the basis of much of British education has been upon the classical language of that country; while from a more immediate consideration, in this hour when the face of history is being changed, Greece has been an ally that has shown that the forces of totalitarianism can be faced by resolute mind and an equal resolution in arms. Behind this document there is further a certain atmosphere of tragedy, for the signature with which it concludes is that of General Metaxas, a great friend of Great Britain, and one who had always encouraged British cultural institutions as they developed in Grecian territory. Further, though his signature nowhere appears, it is common knowledge that on the British side the initiative for this cultural bond came from that dynamic personality, Lord Lloyd, who, through the British Council, was transforming the cultural relationship of Great Britain with foreign countries.

The articles of this Treaty are modest enough. Cultural institutions in the two countries are to be given all proper encouragement and possibility for development. Students and professors and men of learning are to be welcomed equally in London and in Athens. Further, an attempt is being made to ease the entanglement of university regulations which have hampered the passage of students from one country to another and made less easy that fraternity of scholarship which existed in the Middle Ages. Above all, the British traffic of the mind in books and periodicals is to be promoted with as little impediment from customs duties, import quotas and other "relevant regulations" and all such taxes upon knowledge as may be possible.

It is particularly welcome that this Treaty of culture is not confined to any single branch of learning, but that science is to be encouraged along with art and letters. The British Council has already anticipated the action proposed by the Treaty in bringing to Great Britain a number of young Greeks, some of whom are still in British universities, and among them there are young men of science whose work has been reported as reaching a high level of distinction. Nor are the signs lacking that the British Council fully realizes that its definition of culture must include British achievements in medicine and engineering and the pure sciences, and that in due course it must organize the best of expert opinion in Great Britain to break down any intellectual insularity that may still remain. The Treaty belongs to the things which are permanent and will not only survive the War but will also become more active and real once this conflict is over. We live to-day in the sullied atmosphere of propaganda, and it may be that under the conditions of modern warfare that is inevitable; but when peace comes it is through instruments such as this cultural treaty with Greece that British contact with foreign countries should be based.

The pressure of war allows but little leisure for tributes to be paid to the dead, and the individual is likely soon to be forgotten in the major stress of events. In the few pages of this convention there remains a tribute to Lord Lloyd which should encourage those who are engaged upon the work of the British Council to increase their endeavours, and should make Great Britain affirm that in the future it will carry the best that its learning, both in the sciences and in the humanities, can give to all free peoples who may welcome such a proper and uncontaminating contact.

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* H.M. Stationery Office, 2*d*.

A ZOOLOGY FOR STUDENTS

A Text-Book of Zoology
By the late Prof. T. Jeffery Parker and the late Prof. William A. Haswell. Sixth edition. Vol. 2. Revised by Dr. C. Forster-Cooper. Pp. xxiii+758. (London: Macmillan and Co., Ltd., 1940.) 36*s.* net.

WE can now welcome the appearance of volume 2 of the new "Parker and Haswell" (volume 1 was reviewed in NATURE of October 5). It is the volume dealing with the Chordata, a phylum in which important advances in our knowledge of both fact and theory have been made and needed incorporation to bring it up to date. Its format, like its companion volume, is larger than that of the previous five editions, the last of which was published in 1930, and the type is slightly larger. The pages number 758 as against 683 of the previous edition. More space has also been gained by the omission of the two general chapters on distribution and philosophy. Older readers will perhaps regret the loss of these, but, however much they might have desired their retention, it is fair to say they only represented a résumé of our knowledge on these topics forty-three years ago. It is justly pointed out in the preface that to have brought them up to date would have involved their expansion, and consequent enlargement of the volume beyond reasonable bounds. The space thus gained has been used for the incorporation of a very considerable amount of recent information.

It must not be thought that this edition is simply the last with additions; it is reorganized, largely re-written, and to a considerable extent re-illustrated: it is in effect a *new* edition and not simply a revision. A large number of the old illustrations have been excluded and new ones, including some excellent photographs, added, and of these about thirty appear to be published here for the first time. Although they are fewer in number (656 as against 1,169) they actually form a more useful collection, and the standard of reproduction is throughout excellent. Perhaps the most serious criticism regarding the illustrations is the retention on p. 350 of Wiedersheim's very diagrammatic and not accurate representation of the venous system of Salamandra when more precise information is available. Three diagrams of the suggested phylogenies of the fishes, the reptiles and the mammals plotted against the geological periods as a time-scale form useful additions, as many students gain a clearer idea from such schemes than they do from any amount of straightforward text.

The text-figure legends are fairly uniform and unusually commence with the scientific name in black face type unless the subject requires other treatment. The same consistency has not been maintained with regard to nomenclature, and it is rather curious that well-known names have been rejected, correctly, of course, in some instances, whereas in others they have been retained. Thus, to take a few examples, Bdellostoma becomes Eptatretus, Scyllium becomes Scylliorhinus, Echidna becomes Tachyglossus, Galeopithecus becomes Cynocephalus; but, while Ceratodus becomes Epiceratodus in the heading of the section, it remains Ceratodus in the text. On the other hand, Branchiostoma remains Amphioxus, *Lampetra fluviatilis* remains Petromyzon and *Oryctolagus cuniculus* remains Lepus. While on the subject of names, the diagram on p. 188, in which a spine is clearly indicated on the anterior margin of the anterior dorsal fin, is surely that of Squalus, although it is labelled Brachælurus. This question of correct naming is important in a students' text-book, for any incorrect names that are acquired in early years are liable to persist in an amazing way: it is just as easy for the beginner to learn the right name. In line four from the bottom of p. 460 Neornithes should read Neognathæ. On p. 639 it is stated that the mammary glands are modified "sebaceous glands": why not say sweat glands, since that has been established beyond reasonable doubt by various workers, and the mode of producing secretion differs fundamentally in the sweat and sebaceous glands?

In correspondence with the unequal rate of advance in our knowledge of the fundamental facts in different groups, varying amounts of revision have been necessary in dealing with the different classes of the Chordata. Least alteration is noticeable in the Hemichorda, Urochorda, Amphibia and Aves. The sub-phylum Agnatha, the Pisces, Reptilia and Mammalia on the other hand, have been far more drastically treated, and it may be said at once that this is a much needed improvement. In the first three in particular considerable stress has been laid on the palæontology of the groups. Some knowledge of the palæontology is, of course, essential to the understanding of the relationships of the living groups, since they are but the end twigs of a tree the main branches and trunk of which can only be revealed by this method of approach. On the other hand, it is true that many students of zoology unfortunately have no knowledge of geology, and they can never hope to see many of the types dealt with, or, if they did see them, they would be quite unable to interpret them. It is in the groups that they have been most critically re-written that palæontology has made the most conspicuous contribution to our knowledge, and it is fortunate that the revision has been made by an acknowledged master in that field. The volume is furnished with an exceptionally full index.

Here then we have the completion of the new "Parker and Haswell" arisen Phœnix-like out of the ashes of its former self, the good features remaining, but embellished and burnished by its ordeal of fire. Such a thorough revision has long been needed, and it has been carried out in a most praiseworthy manner. Students for some time to come will have reason to thank both the revisers of the volumes and the publishers for once again firmly securing "Parker and Haswell" on its pedestal as the most useful text-book of its size and compass in the English language. It is a pity that the price is so high, each volume costing as much as the two volumes did in the original edition, but for that the publishers are not to blame. It is due to causes not under their control, and, compared with other advanced text-books, it is certainly good value for the money.

C. H. O'DONOGHUE.

A HISTORY OF MYCOLOGY

The Advance of the Fungi
By E. C. Large. Pp. 488 + 6 plates. (London: Jonathan Cape, Ltd., 1940.) 18*s*. net.

THIS very interesting book is a history of research on plant diseases, especially those due to fungi. It is written in the new style, in which the events of the history of science are related to their social background, and it contains much fascinating material.

The author begins with an account of the potato murrain. Its appearance in England was noted in August 1845, and at once received the attention of the leading botanists, including Dr. John Lindley and the Rev. M. J. Berkeley. Within a few weeks, news of the spread of the disease came from Poland, Germany, Belgium and France, and from nearly all parts of England.

There had been a peculiar change in weather during the summer. The early period had been fine, with temperature above the average, and had then been suddenly followed by three weeks of exceptionally damp and cold weather. Many botanists, with Lindley at their head, believed that the bad weather caused the plants to be overladen with water. This produced a sort of dropsy, and putrefaction. Berkeley, on the other hand, was impressed by the mould observable on the diseased plants, and suggested that it was the cause and not the consequence of the disease.

This raised once more the conception of the nature of disease in general. Were diseases intangible entities or were they due to concrete causes that could be seen and controlled? It is notable that Berkeley, the Christian clergyman, was the most resolute in the rejection of all nebulous and transcendental explanations of disease, while the more materialistically minded men of science were the most eager to espouse them.

This wonderful man was of commanding presence and robust physique. He was educated at Rugby and Cambridge. He was a perpetual curate, and maintained a large family on a very small stipend. He had to take in pupils to increase his means, and he was active in his parish. He was a good classical scholar, and read all the proofs of the "Genera Plantarum" by Bentham and Hooker. He was the leading authority in England from 1836 until 1870 on fungi. He collected a herbarium of ten thousand species of fungi, which was ultimately acquired by Kew, and he described nearly six thousand new species. Finally, he retired on a minute civil pension.

While the potato murrain was stimulating researches that helped to transform the conceptions of plant disease, and consequently of human disease, it was an instrument in profound political changes. Sir Robert Peel was seeking plausible reasons at the time for the repeal of the Corn Laws. The murrain attacked the Irish potato crop and destroyed the food of a large section of the Irish population, and Peel found in this event most moving arguments for free imports of corn. Thus the potato murrain was a trigger which released Britain on her career of free trade in the nineteenth century. Some details collected by the contemporary *Times* reveal the conditions of the Irish labourers. The annual wages were about £3 18*s*. A pig worth about £4 was reared, making an annual monetary income of about £7 18*s*. From this, about £5 rent was paid, leaving £2 18*s.* to buy meal, clothing, tools, candles, medicine and drink for the year. The food consisted almost entirely of home-grown potatoes, each person eating from eight to fourteen pounds per day.

The fungi of the potato murrain advanced with vengeance on the Irish population. Relief measures became imperative, but they were conducted with a meanness that has left a scar. Are we not now having to pay for such errors ?

Among the many interesting sections are accounts of the researches of the Tulasnes, Tillet, and de Bary. The Tulasnes were devout Catholics who made wonderful drawings of fungi in order to reveal the beauty and infinitude of the Creation. Their researches were dedicated to the glory of God, and in their zeal they sometimes saw things that did not exist ; but this was trivial compared with the discoveries they did make. The metamorphoses of the fungi were very complex, and their obstinate belief in the subtlety of Nature liberated the imagination of the men of science, and assisted them to discover the almost incredible series of changes.

Tillet's brilliant researches in 1751 on bunt in wheat, with his one hundred and twenty adjacent plots containing differently treated seed, so that the results on each could be compared, are described ; and the exact researches of the acute and intelligent twenty-two-year old de Bary in 1853.

The later sections of the book on such subjects as chemical fungicides are not less interesting.

There is one subject, however, in which the author is perhaps a little unfair. He writes hard words about Lyon Playfair, who was consulted on the problem of the potato murrain in Ireland, and gave advice that was of little scientific value. He was a chemist, and did not know much about fungi, and he was also a free-trade individualist particularly anxious that the relief for the starving Irish should not undermine the individualistic strand in their moral fibre.

Playfair's performance on this occasion was not one of his happiest ; but in other directions he gave the most signal service to science. The success of the Exhibition of 1851 and the fruits of the scientific institutions founded with its profits are largely due to him, and his combination of scientific knowledge with political skill was, on the whole, of great value. He was one of those rare statesmen of science who could coax, wheedle or bully governments into making more use of science, and more of his type would be very useful to-day. J. G. CROWTHER.

TEACHING PHYSICS

The Demonstration Laboratory of Physics at the University of Chicago

By Prof. Harvey B. Lemon and Fitz-Hugh Marshall. Pp. iv+127. (Chicago : University of Chicago Press ; London : Cambridge University Press, 1939.) 9*s.* net.

THE reactions of scientific workers to war are in one respect like those of all normal men. Self-preservation comes first ; after that, some can think only of bigger and better destruction. A book dealing with so constructive a process as education in the physics laboratory can have little present interest for them. However, for those who both turn and escape from destruction to construction, the book has a very special interest.

Teaching physics is a new subject. When J. J. Thomson first began in the early 'seventies, there were only six physics laboratories in England. Now there are more than three hundred. Their rapid growth has been haphazard. Courses in practical physics were planned to train students both to use physical apparatus and to understand theoretical physics. The dual purpose of using practical physics to train both hands and head has resulted in a tradition in the universities that each student must spend many hours each week in the physics laboratory. To what extent this is necessary is doubtful. Workshop and glass-blowing bench give better hand training. Practical physics of the teaching laboratory is an inefficient way of training hands. For students who follow instructions as if they were cookery recipes, it is no better trainer of the head. In the Ryerson Demonstration Laboratory of Physics at the University of Chicago, Prof. H. B. Lemon and Dr. F.-H. Marshall have broken with tradition by providing, in effect, the maximum training of the head with the minimum of hand. About 240 experiments covering all the main phenomena of physics from inertia to X-rays and cosmic rays are completely set up in more or less permanent form so that they 'work' without fail or fake.

The laboratory started as a physics museum for showing physical phenomena rather than historical apparatus. The equivalent in Great Britain is in that small part of the Science Museum exhibits at South Kensington to be found, oddly enough, in the children's section in the basement. Plans, very clear photographs and notes enable the physicist easily to visualize the Chicago laboratory. The authors give also a thorough discussion of its different uses. Over a period of seven years about 40,000 students and visitors have seen and used the experiments as part of introductory general courses or 'surveys', as preparation for the equivalent of the Intermediate B.Sc. and 1st M.B. courses, or as part of the training of teachers. Public 'open evenings' have also enabled citizens of the community around the University to observe physical phenomena directly instead of merely reading about the rather mysterious physical universes presented to them, with or without alleged theological implications, in popular science literature.

While the demonstration laboratory gives the student little practice in laboratory techniques, it must be remembered that the majority of those studying physics in a university never become physicists. There can be little doubt that developments as striking as those of biochemistry will be made wherever two sciences overlap. A biophysicist, for example, will have to know all the main phenomena of physics, chemistry, botany and zoology. The demonstration laboratory would help in acquiring the knowledge quicker than would the ordinary practical laboratory, and the time saved could be spent upon mathematics and upon the specialized laboratory techniques actually needed for future use.

This volume can therefore be very strongly recommended to the attention of all concerned with teaching any of the sciences. To the reviewer it carries deeper significance. The object of the laboratory to which it directs attention is "first-hand contact with the phenomenological source material of the science", that is, with observable facts. These are the only things in which agreement between human beings has ever, so far, been reached. While the men of action are urging mankind on in a struggle for *unobservables*, values and the like, the ineffectual intellectual may well wonder if the ideas behind the Chicago demonstration laboratory—the stressing of *observables* in which men agree—may not lead to greater human happiness.

W. H. GEORGE.

METHANE AS A FUEL

Methane
Its Production and Utilization. By Dr. J. P. Lawrie. Pp. 66. (London: Chapman and Hall, Ltd., 1940.) 6*s*. net.

AT the present time there is very little natural petroleum in Great Britain, and the country is almost entirely dependent upon imports for supplies of fuel oil and petrol. In this book Dr. J. P. Lawrie has shown that there are available substantial quantities of methane gas which, if used as an alternative to petrol, could replace a large proportion of the fuel at present being imported.

Methane occurs in coal deposits, and is released as fire-damp when the pressure of overlying deposits is eased during mining operations. While there are no actual figures obtainable of supplies of gas available from the blow-holes of mines, Dr. Lawrie instances two mines which produce 10,000,000 and 1,000,000 cubic feet of methane per day. As there are 1,250 collieries in Great Britain, there is no doubt that the total quantity of gas available from this source is substantial. At the present time all the methane from mine blow-holes is wasted, and while private enterprise is aware to some extent of the value of these supplies, little can be achieved until a survey is made by an official body.

Methane is also found associated with oil, and the recent search for petroleum in Great Britain has indicated that supplies of the gas are available from this source. For example, in Scotland there is a site from which 12,000,000 cubic feet of practically pure methane can be obtained per day. Quantities have also been revealed in borings in Derbyshire, Sussex, Yorkshire, and Lancashire.

Apart from these natural occurrences, methane can be obtained from the treatment of coal, from ordinary coal gas as supplied for towns' use, coke-oven and water gas. Production from these sources, however, involves the utilization of an existing fuel. Thus, in relieving the demand for petrol by the manufacture of gas, either an indigenous or an imported fuel is being consumed. In war-time, particularly, the relieving of one shortage might merely have the effect of causing another. There is, however, another source not falling within this category, and that is sewage. Dr. Lawrie is of the opinion that the production of methane by the digestion of sewage sludge offers the most satisfactory source, apart from supplies from natural sources. Summarily, he calculates that quantities of methane from all known sources can supply not less than 7 per cent of the country's peace-time requirements of fuel substituting petrol.

FOUNDATIONS OF TROPICAL AGRICULTURE

By Prof. C. W. Wardlaw,

University of Manchester (formerly of the Imperial College of Tropical Agriculture)

> "'You must certainly have a vast estate,' said Candide to the Turk.
>
> "'I have no more than twenty acres of ground,' said he, 'the whole of which I cultivate myself with the help of my children; and by our labour we avoid three great evils, idleness, vice and want.'
>
> "'Elevated stations,' said Pangloss, 'are very dangerous, according to the testimonies of almost all philosophies.'
>
> "'I know,' said Candide, 'WE MUST CULTIVATE OUR GARDEN.'"
>
> Voltaire.

Imperial College of Tropical Agriculture, Trinidad

Via cilendi haud facilis

The Imperial College of Tropical Agriculture in Trinidad was founded as the West Indian Agricultural College in 1921; to provide instruction in tropical agriculture and in the cultivation and preparation for market of tropical produce of every kind, and also to continue the work of the Imperial Department of Agriculture for the West Indies. In 1924 the name was changed to "The Imperial College of Tropical Agriculture". Two years later the College was incorporated by Royal Charter, and in the following year it received the patronage of M.H. the King. It is now the recognized centre for post-graduate training in tropical agriculture for the agricultural services of the Colonial Empire.

The Oldest Industry

As an institution for teaching and research the Imperial College of Tropical Agriculture is still in its first youth. Yet its roots are deep, for it has assimilated to itself the oldest and most honourable traditions in the world: man's need to till the soil and make it bring forth abundantly.

The way of the cultivator is hard. In the realm of agriculture man enjoys at best but a qualified success. In the Middle Ages, when famines and plagues periodically swept the face of whole continents, the heart-breaking vicissitudes of agriculture were recognized and passively accepted as being something in the nature of things, to be tolerated with patience and fortitude. To-day we still recognize the endless complexities and difficulties of agriculture, but our mood is no longer one of submission: we know that its problems, be they ever so complex, are not insoluble. With the passage of time science, in her many forms and even in her youngest branches, has been recruited to the aid of the oldest industry; over the whole world agricultural industries are being succoured and assisted as never before. Resignation in the face of famines, plagues and kindred agrarian mishaps, is no longer conceivable. The combination of the methods of science with the age-old art of the cultivator constitutes a new and unprecedented phase in human endeavour, and we strive with the heartening assurance that in spite of all difficulties we shall yet venture through adversity to success.

From Cancer to Capricorn

The citizens of medieval Europe who used spices from the distant Orient to preserve and give flavour to their food, and knew something of the strange exotic merchandise that came by caravan and quinquereme from the vast and little-known world beyond the Mediterranean basin, were yet entirely unaware of the enormous wealth that remained—and, be it said, to this day still remains—to be exploited in the tropical belt. That a swamp reed with a sweetish sap would one day be the basis of a major industry the world over; that bananas, in whose shade wise men of the East sat in pious contemplation, would give rise to a marvellous industry in the New World; that citrus fruits from the Orient would find their way to all lands where the hot sun beats down; and that the many new plants, maize, potatoes, tobacco, to mention only a few discovered by the Conquistadores in the New World, would become infinitely valuable sources of food in the Old: all these, and a hundred others, of the wonderful possibilities that lay untouched between the bounds of Cancer and Capricorn, were unknown to our medieval ancestors, yet but awaited the day when men would set out in search of new lands, to bring back undreamed-of spoil.

More often than not the gold that the Conquistadores sought with such incredible energy and ferocity failed to materialize. Nor, with some rare exceptions, did they realize that the real and enduring value of their discoveries and conquests lay, not in mines, but in those vast tracts of rich agricultural territory found by them in that equatorial belt which imaginative geographers have described as the Torrid Zone. Here, indeed, in the

Fig. 1.
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE: MAIN BUILDING.

newly found realm of tropical agriculture, was wealth personified, a veritable El Dorado for the unnumbered generations that would come after.

RAISON D'ETRE

From Cancer to Capricorn, whether deluged by tropic rain, or starved for water, lies a vast area of which the potential productiveness of the food and commodities that men require has scarcely begun to be realized. But already, because mankind tends to blunder on its myopic way by a process of trial and error, there is much in the sphere of tropical agriculture that is faulty, wasteful and inefficient, and which represents an abuse both of opportunity and material—this in an industry the welfare of which is of fundamental importance to all. For posterity as for our own generation, for all the many peoples scattered over the face of the earth, it is now recognized that the vast resources of the tropics should be treated in no haphazard fashion but should be afforded all the advantages of the accumulated knowledge of agriculture, the steadying guidance of an enlightened administration, and the unstinted assistance of science. To this end the Imperial College of Tropical Agriculture was founded, that its students should go forth to disseminate a new knowledge and idealism to the farthest ends of our great Colonial Empire.

AMENITY

For those to whom the tropic urge has proved irresistible it would indeed be difficult to begin a career in circumstances more favourable than those provided at the Imperial College of Tropical Agriculture. A green and pleasant land, Trinidad provides good living conditions, ample scope for recreation, a wide variety of interests, and, not least, a friendly and kindly people whose hospitality is unstinted. If a man be at all adaptable, he can find in Trinidad most of the things that make for happiness and a sense of life well lived. There must, indeed, be few places in the tropics of which as much can be said.

Although it is now more than four hundred years since the first European visitors went to the shores of an island which the aboriginals called Iere—the 'Land of the Humming Bird'—Trinidad is still unspoilt, and for those willing to explore, is a land of adventure and romance. From coast to coast a marvellous profusion of vegetation greets the eye; untouched virgin forests still brood with the solemnity of a thousand years, and the vast gleaming swamps are bright with the plumage of wild fowl. Tucked away in a fold of her green mantle, Trinidad hugs to herself one of the wonders of the world—the Pitch Lake where Sir Walter Ralegh once caulked his ships. Which thought almost tempts us into the byways of digression, for Trinidad possesses a background of remarkable

Fig. 2.
IMPERIAL COLLEGE OF TROPICAL AGRICULTURE: FARM BUILDINGS.

historic interest. Conquistadores were there in olden days, in search of El Dorado, and, in the murky waters of the Orinoco that lave her shores, many hard-fought naval engagements took place. As to her peoples, the island has become the adopted home of many nationalities, and life is colourful and interesting in proportion.

And so we come to the College.

Almost like a university with its atmosphere of detached calm, the College buildings, solid, dignified and with a sense of spacious repose, are set on an expansive savannah, a green pasture, kept trim and orderly, to which shapely angeline and saman trees lend an impression of coolness and grace. Round the savannah are various red-roofed laboratories, students' hostels and staff houses, while beyond, the eye rises to a densely wooded mountain-side cleft by deep valleys, with a Benedictine monastery perched in high seclusion.

DIDACTIC

The young men destined for the Colonial Agricultural Service are selected with great care from home and dominion universities and from agricultural colleges. As a rule they have already taken an honours degree in science or agriculture, but personality, social qualifications and physique are also considered essential for a service that is as exacting as it is many-sided.

After a year at the Cambridge School of Agriculture, the cadets proceed to Trinidad for a final year of studentship, which initiates them into a great service—the Colonial Agricultural Service. For most of them it must indeed be a wonderful year. The glamour of the tropics, the strange and varied experience of living in a new country peopled with many races, and, not least, the feeling that they are at length coming to grips with their life-work.

The principal function of the College is the instruction of students in tropical agriculture and methods of research relevant to modern agricultural requirements. Accordingly, a closely knit course has been built up over the years whereby the student is given a thorough insight into, or, if he is not a specialist, a good working knowledge of the several sciences which play the part of handmaiden to that vast, comprehensive whole—agriculture.

A knowledge of tropical soils—which are not always as good as the untravelled layman has been led to suppose—is, of course, fundamental. Soils make a whole universe. The problems of their formation, utilization, deterioration and regeneration under the many and varied types of climate and systems of cultivation found between Cancer and Capricorn, the methods of measuring their actual or potential fertility, and of studying the lives of the micro-organisms which inhabit them, are all made the subject not only of discourses in the lecture room, but also of demonstration and experimentation in the field and laboratory.

From the good earth spring the tropical crops—a grand and goodly host of them the variety and abundance of which far exceed the common knowledge of those who have never stirred beyond the confines of temperate lands. So, in his agricultural classes, and with the help of a living museum on the College Farm and in the island as a whole, the student becomes acquainted with the vast array of vegetable commodities that can be produced throughout the equatorial belt: rice, pulses, maize, among cereals; sugar cane, cotton, tobacco, cocoa, coffee, spices, rubber, bananas and exotic fruits innumerable, oil, fodder, and fibre crops, to mention only a few of the economic plants with which he may have to deal later in his career. But that is only part of the agricultural course. The study of livestock, its care and improvement in the tropics, the use of implemental tillage adapted to different needs and conditions, the methods of field experimentation, and many other aspects of knowledge and practice, all find their place in the curriculum.

As well as being marvellously and variously productive of the goods that man requires, Nature, in her infinite variety, has also at her command the forces of dissolution and decay. Diseases and pests emerge unheralded from the unknown to claim a heavy toll in the domain of agriculture. So in preparation for the maladies which will inevitably beset his crops wherever he goes, the student's education includes a survey of fungal diseases and insect pests and the methods by which they can be combated.

Faced with the large assemblage of tropical crops more or less completely new to him, the student, already a botanist, perforce must continue his botanical studies, not merely to familiarize himself with their structure, habitat and mode of life and the influence which different environments exert on their cropping power, but also to consider to what extent, by breeding and selection, new types, more productive, more disease-resistant and more adaptable to different environments can be obtained. Here it may be noted that the College course is so arranged that soil, agricultural, botanical and pathological studies, as well as field demonstrations, are carried out crop by crop in the closest conjunction.

Not last or least, there is instruction in the science of economics, for agriculture, as well as being an art and a science, is also a business. So is there a need for instruction in the methods of economics as applied to agriculture in order that the true sources of wealth may be adequately understood, wasteful methods eliminated, and the financial and administrative fabric so adjusted as to make for increasing improvement, not only in the mere matter of pelf, but also in respect of the wider aspects, internal and external, of the social well-being of the community.

From this brief and rapid survey some impression may be gained of the wealth of new knowledge and experience that awaits the agricultural cadet. Nor is that all. He also receives instruction in veterinary science, and being himself an animal liable to the ills that beset the empire builder in torrid climes, is duly instructed in the niceties of tropical sanitation and hygiene.

So, at length, after a year that must seem all too short, the student stands forth, as yet inexperienced—a defect which time will rectify—but clad in the armour of knowledge, the torch of science in his hand, ready for service and determined "To strive, to seek, to find and not to yield."

Perhaps, if you travel the world and penetrate into strange and remote places, you may meet old College students. They are to be encountered everywhere throughout the Colonial Empire and Mandated Territories, in East and West Africa, Malaya, New Guinea, the Solomon Islands, British Guiana, the West Indies, Palestine, the Sudan; and they are doing splendid work. This aspect of British Imperial service must be the envy of the world. For while other countries may also possess fine colonies, none, without exception, can boast of such a service, unified by the fellowship that comes from the system of training and the fact that they have one and all studied in the same College. Indeed, the bonds that unite past students not only among themselves but also to their former professors at the College, has through the years created a system of correlated endeavour seldom to be encountered.

DIPLOMATES

In its attempt to provide men for the agricultural services, official or commercial, the College casts a wide net. With the passage of time a diploma course has been evolved for the instruction of students of school-leaving age who are not proceeding to a university but who desire to qualify for a career in agriculture. These students receive a well-balanced training in the sciences pertaining to agriculture, in the many aspects of agriculture itself, and, if they wish to specialize in that subject, in sugar technology. For the latter purpose there is attached, to the College a model sugar factory, where a thorough training in all matters relevant to the production and preparation of that goodly commodity may be obtained. The members of the diploma course are derived principally from the West Indian islands and British Guiana; but they are also occasionally recruited from regions considerably more remote, while periodic accessions from the French West Indian Colonies and from the Latin American Republics provide a pleasing note of cosmopolitan variety to the College scene.

Diplomates may also play an important part in promoting the welfare of tropical agriculture. They are eligible for appointments in West Indian departments of agriculture, they do important work as sugar technologists, and are recruited as managers or advisers to some of the larger estates.

LIBRARY

The literature of agriculture, extensive and varied as its theme, cannot be adequately treated in a few words. But suffice it to say that in the College Library there has been assembled not only a comprehensive and representative collection of books, but also a wealth of information in the form of bulletins and memoirs, pamphlets and periodicals, from all parts of the world. Even in the world of letters modern conditions call for speed and efficiency; to meet this need the Library has been indexed and catalogued on a system whereby the information available on any subject can be immediately obtained.

THE SCIENTIFIC WAY

If the way of the agriculturist is hard, he no longer stands alone. In the attempt to control the wayward forces of Nature, the resources of modern science are daily being applied on an increasingly extended front—a campaign in which the Imperial College plays its part, for by its constitution it is an institution for the promotion of research as well as for the propagation of knowledge. Because its functions are imperial, and its work intended to provide information for agricultural officers in their many spheres of activity, the major investigations undertaken fall into that category which may perhaps best be described as 'fundamental applied research'; but local problems are also tackled in collaboration with West Indian Departments of Agriculture.

Of necessity, the crops grown in the West Indies provide the raw material for investigation; but the problems selected for study are such as will tend to elucidate basic scientific principles rather than to yield results of immediate practical importance but of limited application. Not infrequently the research projects call for the collaboration of specialists in different fields. To illustrate a single instance of a College team in action and of the way in which investigators throughout the Empire become linked together in a common cause, reference may be made to banana research. Some twelve years ago the heavy losses resulting from the rapid spread of Panama disease—a soil-borne disease of great severity widely distributed throughout the tropics and affecting the Gros Michel banana, the principal variety of commerce—gave rise to a scheme requiring the services of a pathologist to study the malady under field conditions, of a plant breeder whose task was to produce commercial hybrids resistant to the disease, and of a physiologist to investigate the cold storage and ripening behaviour of resistant varieties or hybrids which might be used as commercial substitutes for the Gros Michel. These three sub-divisions of the research programme were centralized at the Imperial College, and among other things led to the construction of plant quarantine houses and of a Low Temperature Research Station. But only part of the story has been told. To search for resistant varieties which might serve as substitutes for the Gros Michel and to provide materials from which desirable hybrids might be obtained, collectors from the Royal Botanic Gardens at Kew were sent to the East, the original home of the banana. In this unusual quest, which still continues, forestry and agricultural officers in remote places have taken a not inconsiderable part. Further, in order that diseases which have attained to epidemic proportions in the Orient might not be introduced into the West Indies, it was necessary to prepare a special quarantine house at Kew and one in Trinidad to provide the necessary safeguards. Meanwhile, in Trinidad, with the passage of time, new and promising hybrids have been raised and their carrying qualities tested, and a vast amount of useful information has been obtained and published on the botany of this important genus, the behaviour of different varieties and hybrids in storage, the basic physiological processes involved, and on the host of diseases which are liable to cause losses in the field and wastage during transport and ripening. By such a combination of effort it is evident that not only are present needs being served, but also a sure foundation of knowledge is being laid down for the future.

The fascinating story of banana investigations is only one illustration of the many research projects now receiving attention at the College. Reference might equally have been made to work on such crops as cacao, citrus, sugar cane ; to storage investigations on exotic fruits ; to soil surveys and kindred earthy topics ; to economic probings into the workings of tropical industries and social systems ; and to the many and varied problems of entomology and mycology. Lastly, it may be noted, a special point is made of introducing students to these manifold activities ; as a result they go forth, not only with some knowledge of the methods by which problems may be tackled, but also with the feeling that they have, to some extent, become personally identified with researches whose value will become increasingly evident with the passage of time.

In a free world the fruits of knowledge should be available to all. This ideal pervades the work of the Imperial College of Tropical Agriculture. The results of all investigations are published in appropriate journals, and scholarly contacts are maintained with research workers throughout the world. Visitors are made welcome and given the fullest access to such information as they may require. So is the good name of the College being spread abroad, not merely as a scientific adjunct to local aspects of tropical agriculture, but also as a centre of teaching and research where sincerity of scholarship, integrity of purpose, and a realistic vision for the future, must inevitably play a profoundly important part in aiding humanity in a great practical need—to cultivate its tropical garden.

THE FOUNDATIONS OF EMPIRICAL KNOWLEDGE

By Prof. Herbert Dingle,
Imperial College of Science and Technology

For more reasons than one it is important that those who are engaged in acquiring empirical knowledge should sometimes ask what it is precisely that they are doing, and what is the significance of their work. Much depends on the answer to this question, for in the long run it determines the direction which history takes. High explosive and incendiary bombs may destroy the material products of civilization, but if civilization survives it can produce others : a false idea is a bomb of the delayed action type which may destroy civilization itself. For this reason I have on more than one occasion protested against the false notion, coming unfortunately from authoritative sources within the world of science itself, that what we call empirical knowledge can be acquired without recourse to experience; and that future experience must conform to it.

This illusion is spreading, and philosophers are becoming its victims even more seriously than men of science. For whereas the scientific apostates substitute for experience the comparatively respectable goddess of reason, a vigorous and growing body of philosophers look to grammar as the source and essence of knowledge. Thus, R. Carnap, a leader among this group, maintains that what in science is usually called the ascertainment of an empirical fact by which a given hypothesis can be tested, is more properly described as the reduction, by formal conventional rules of syntax, of certain propositions, which constitute the hypothesis, to "observation-" or "protocol-sentences". These "observation-sentences", however, do not express the possible results of observation: the only criterion for determining their truth or falsity is the possibility of including them within the language used. But if the rules of the language make this impossible, we need not reject the hypothesis: "there always exists the possibility", Mr. A. J. Ayer quotes Carnap as saying, "of maintaining the hypothesis and renouncing acknowledgment of the protocol-sentences". Experience is eliminated altogether: knowledge consists of talking, and whatever you say is true if you do not contradict yourself.

In such a situation the appearance of a book on the foundations of empirical knowledge by a philosopher so acute and well informed in certain directions as Mr. Ayer[*], is a matter of more than casual interest. It may be said at once that while Mr. Ayer has many affinities with the language school of philosophers, he does not share their determination to sidetrack observation: he believes that empirical knowledge originates only in experience, and that if you want to know whether the sentence "mercuric oxide is red" is true or not, you must look and see; it will not help you to study the rules of syntax. For this much must be forgiven him, and it may be that the service which he is thereby rendering to his day and generation is greater than he knows. Moreover, within the limits he sets for himself, he thinks with extreme clearness and expresses himself admirably. The book is a real pleasure to read. There is nothing here of the nebulous incomprehensibility which one often finds in philosophical works, and which one can only hope is a sign of profundity of thought. A sentence of Mr. Ayer's means one thing and one thing only, and you know what that thing is. Sentences are not repeated needlessly, and they succeed one another in perfect logical order. Apart from the rather annoying fact that the references in footnotes to other pages are usually wrong, there can be nothing but praise for Mr. Ayer's presentation of his case.

"My main purpose," Mr. Ayer writes, "has been to resolve the philosophical problems which are commonly brought under the heading of 'our knowledge of the external world'." The fundamental question which he considers is this: when (to use ordinary language) I "observe" a material thing, do I actually observe that thing, or something else (a "sense-datum") related thereto? The latter would appear to be what I really observe because when I look at a shilling, for example, from a certain angle and in a certain light, I see a yellow ellipse, while from another angle I see a black line; but the shilling itself is a white circular disk. A generalization of such facts as these leads some philosophers to say that what we observe are always sense-data, although in special cases the description of the sense-data may be identical with that of the material thing. Mr. Ayer, however, maintains that the question is a purely verbal one. I can always say I observe a material thing if I give to the phrase "material thing" the requisite meaning. In my example I can say that I observed the shilling on each occasion and that it was a yellow ellipse at first and changed to a black line later. It would be a curious way of speaking, but it would not lead us into contradiction.

The question "Do I observe material things or sense-data?" therefore cannot be decided by an appeal to experience as could such a question as "Do I see sovereigns or Bank of England notes?" Empirical facts can be described consistently whichever answer we give, and so the answer simply states what language we intend to use. If we appeal to facts, "it can be only to show that one form of expression is more convenient than the other". Mr. Ayer chooses the sense-datum language because, as he says, it is more convenient, and he proceeds to discuss how material objects can be "constructed" out of sense-data. Other questions also are dealt with, but this is the central one. What the thesis amounts to is this: the only condition a language has to satisfy is that its rules are free from self-contradiction, and between any two such languages the only ground for choice is convenience.

The first thought which all this arouses is that if our aim is merely to avoid contradiction, there is an admirable way of achieving it; namely, by saying nothing at all. This is also extremely convenient. We conclude, then, that philosophers should henceforth remain for ever silent. But Mr. Ayer would doubtless object that of course we want to describe something—that something being, as he admits, experience. But if that is so, then surely there is another ground than convenience for choosing a language; we would prefer the one that enables us to say the most about experience. Here we see the grotesque inadequacy of Mr. Ayer's discussion to his professed subject. He has set out to discuss "the foundations of empirical knowledge"—"the philosophical problems which are commonly brought under the heading of 'our knowledge of the external world' "—without reference at all to the facts that during the last three hundred years there has been a philosophical movement (now called science, thus enabling philosophers to ignore it) which has enlarged the scope and deepened the significance of our knowledge of the external world to such an extent that the knowledge thereof obtained otherwise is by comparison negligible; and, second, that the condition which has made this possible is that men of science have progressively changed their language over and over again, invariably in order to be able to say more and more, and almost, if not quite, invariably from a more to a less convenient one. I will take two outstanding examples of this; but first let us see what kind of language science actually does use.

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[*] The Foundations of Empirical Knowledge. By Alfred J. Ayer. Pp. x+276. (London: Macmillan and Co., Ltd., 1940.) 10*s.* 6*d.* net.

It is not the language of material things or that of sense-data as Mr. Ayer uses the term. It contains such words as "mass", "brightness", "shape", "motion", which represent groups of components of single sense-data. Jupiter is a material thing, but the mass of Jupiter is not a material thing. If Jupiter were to explode, the mass would continue undisturbed in its orbit at the centre of gravity of the fragments, while the material thing would be scattered in a million other places. The brightness of Jupiter is a function of something extending from the sun to the planet and then to the earth. The shape of Jupiter is a function of the number of times a metal bar at Paris would be contained in certain diameters if Jupiter were not moving with respect to it; and so on.

Each of these words can be ultimately expressed in terms of particular components of sense-data of Jupiter, but science is not in the least interested in putting the components together to make a sense-datum or in 'spelling out' Jupiter in terms of them. The mass of Jupiter is associated not with its brightness but with other masses, to give general laws of mechanics; and the brightness is associated not with the motion but with other luminosities, to give general laws of optics; and what science aspires to do ultimately is to subsume all such laws under a general correlation of all experience. The material thing, Jupiter, and the complete sense-datum of Jupiter, are alike without significance in this process, which, I repeat, has given us all but an infinitesimal fraction of our present knowledge of the external world. Yet Mr. Ayer's discussion of the "philosophical problems" relating to such knowledge makes no reference whatever to it, but concentrates on the manner in which material objects can be described in the language of sense-data.

The first example of changes of scientific language which I will take is probably the best known in the whole history of science—the languages used to describe motion. In the Ptolemaic system, motion meant "change of position with respect to the earth". Copernicus changed this to "change of position with respect to the sun". This was a most inconvenient change—so inconvenient that the ordinary man has never made it; he still speaks of sunrise. Even the astronomer makes it very rarely. In the greater part of his work he talks of the celestial sphere, of right ascension and declination, and so on; and the "Nautical Almanac", the indispensable handbook of applied astronomy, speaks practically without interruption in the Ptolemaic language (a fact which, it may be noted, is consistently overlooked by those who hold scientific progress to have been directed by social needs). But the change enabled the astronomer to say more when he wanted to do so. He could, for example, describe the variations of a planet's brightness in terms of the new language but not in terms of the old, and Newton showed him how he could speak of such diverse things as the movements of the moon and the fall of an apple in the same new tongue. Therefore, because of its greater scope, and in spite of its greater inconvenience, that tongue became the official tongue of science.

Time went on, and astronomers wanted to say still more, so Einstein made another change. He recommended that motion should no longer mean change of position with respect to the sun, but the slope of a world-line in a four-dimensional continuum. In that language you can say all that you said before, and more also. You can describe the motions of the planet Mercury, of light passing near the sun, and of the extra-galactic nebulæ. Is it a convenient language? Well, scarcely: it chokes you to speak it, but it allows you to 'say a mouthful'.

My second example shall be the scientific counterpart of one of Mr. Ayer's own—the only one for which I have space. In order to illustrate the equivalence (apart from convenience) of the languages of material things and sense-data, he instances the well-known fact "that a liquid will seem to have a different temperature according as the hand that is feeling it is itself hot or cold". In the language of sense-data, we have here two different sense-data associated with the same material object, and this contains no contradiction. If, however, we suppose that we are directly experiencing the same material thing with both hands, we appear to obtain the contradictory result that the water is both hot and cold. But "to obtain the contradiction it must also be assumed that the temperature of the water with which the vessel is filled is really the same throughout", and this assumption may be supported by the fact that "it is observed to yield a uniform reading on a thermometer". The contradiction may therefore be avoided by asserting that the water was really hot in one part and cold in the other, and hence that thermometer readings, made with the precautions usual in science, give untrustworthy indications of temperature. This would be the account of the matter in the material object language, and, according to Mr. Ayer, it is equivalent to the account in the sense-datum language in everything but convenience.

Again one cannot help asking: What about the scope of the languages? If thermometers cannot be trusted, then the only describable thermal phenomena are our direct sensations of heat and cold. Here is a pretty science of heat! Presumably the fact that the thermometer reads higher in boiling salt solution than in boiling water is "knowledge of the external world", but since our bodies would detect no difference we cannot connect this fact with the difference that we feel between a winter's and a summer's day. The latter is a difference of temperature, but we must invent a new and independent language to express differences of thermometer readings.

What has science done with phenomena of this kind? It has begun by defining the temperature of a body as the equilibrium reading of a thermometer—a mercury thermometer, say—immersed in the body. The difference in the sensations felt by the two hands must then be explained by supposing that they had different temperatures when immersed, and this is consistent with all other relevant facts available. The definition is not so convenient as that of direct feeling, but it enables us to connect together—to "speak about" —a wider range of phenomena. But the range is still unduly limited for the physicist. He cannot measure the temperature of a bunsen flame or liquid air with a mercury thermometer, so he changes his language to one in which temperature means the reading of a 'perfect gas' thermometer. A perfect gas never changes its state, however hot or cold it gets, so that in the new language we can talk about the temperature of anything which the universe may contain. As for convenience, there is, it is true, a slight disadvantage in the fact that neither a perfect gas nor the only equivalent substitute—a reversible heat engine—can possibly exist, and we have to do the best we can with a real gas and make fairly elaborate corrections for its 'reality'. However, the physicist puts up with this, for he has only a pallid interest in convenience: it is the scope of his language that stirs his blood.

One would think that he had now gone far enough. But no; he soon becomes dissatisfied with the perfect gas thermometer and gives the word "temperature" a new meaning: it next stands for "the average kinetic energy of the molecules of a body". This is quite a new departure. In terms of this language he says that the temperature of interstellar matter is something greater than 1000° C., whereas he is quite confident that if a gas thermometer were placed in the matter it would read something near the absolute zero. Again the change is not made for convenience. If anyone thinks so, a page of Willard Gibbs will provide an infallible, though not a painless, corrective. The change is made solely because it enables us to speak of thermal and mechanical phenomena in the same language, and so enlarges our scope of expression.

So when Mr. Ayer tells us that a language which makes a thermometer reading an untrustworthy indication of temperature is equivalent in all but convenience to one in which a thermometer reading is trustworthy, the scientist must beg permission to dissent. It is true that, according to the latest definition, a thermometer no longer indicates temperature, but it is not untrustworthy, for we know why, and can predict when, it will fail. In interstellar space the matter is so rarefied that the thermometer receives impacts from the molecules very infrequently, and radiates away each increment of the acquired energy before the next arrives. To know this is to increase our knowledge, while to reject the thermometer in favour of direct bodily sensations is drastically to restrict it.

The immense and awe-inspiring knowledge of the external world which we now possess, and which continues to grow at an almost incredible rate, is indeed a matter of the deepest concern. What does it all mean? Is it a discovery of unalterable fact, or a creation which our reason can transform as experience grows? How comes it that by taking thought in a particular way, unknown to the ancients, we can add unlimited cubits to our stature and determine the course of the world's history? What exactly are we doing, and what are the potentialities of the ideas to which we are led, when we set reason to operate on experience in the manner which has yielded the bulk of the empirical knowledge which is ours to-day? The man of science, immersed in the process itself, rarely has the time or the aptitude to ponder these questions. He may realize their importance, but it is his chief function to produce the knowledge, not to assess it or discover its nature. For that we must look to the philosopher —to the man trained in the processes of accurate logic and versed in the history of human thought. On the philosopher, in the modern sense of the word, rests a great responsibility, perhaps the most urgent responsibility in the world to-day—that of laying bare the foundations of empirical knowledge so that we may use it with foresight instead of a blind understanding. And when we turn to what one of the most able and promising of the younger philosophers has to tell us on this all-important question, we find that it is mainly a set of speculations on how to translate from one ineffective language into another. If Mr. Ayer were a less significant figure we might in silence leave his book to psychologists, for whom the question it discusses, and perhaps the discussion itself, has some academic interest. It is because of the possibility that he might yet bring his great talents to bear on the problem which he thinks he has already considered that his book deserves serious attention.

OBITUARIES

Prof. H. S. Hele-Shaw, F.R.S.

Henry Selby Hele-Shaw, who died on January 30 at the age of eighty-six, combined in an unusual degree the academic and the inventive mind. Educated privately, he served an apprenticeship for four years as a mechanical engineer, after which he won a Senior Whitworth Scholarship and with it proceeded to University College, Bristol. On completing the course, he was appointed lecturer in mathematics and engineering at Bristol, and a few years after, in 1881, was made professor of engineering. Four years later he was appointed the first professor of engineering at University College, Liverpool. He held this post until his resignation in 1904, when he was appointed first professor of engineering in the Transvaal Technical Institute; after a year he was made principal of the Institute. Soon afterwards the Secretary of State for the Colonies appointed him organizer of technical education in the Transvaal.

On returning from South Africa in 1906, Hele-Shaw set up a consulting practice in Westminster and carried this on with great success until his death. He was president of the Institution of Mechanical Engineers in 1922, and president in 1915 of Section G (Engineering) of the British Association. He delivered the James Watt Anniversary Lecture in 1902, the subject being "James Watt, Inventor". He was an LL.D. of St. Andrews, a D.Sc. of Bristol, and a D.Eng. of Liverpool.

While at Liverpool Hele-Shaw was largely responsible for collecting funds for the endowment of the chair of engineering and for the building of the Walker Engineering Laboratories. It was here, too, that he carried out his experimental work on stream-line flow which established his reputation as a scientific investigator, and for which he was elected a fellow of the Royal Society in 1899.

It was during his early days at Liverpool that Hele-Shaw's inventive ability began to develop. He was much interested in the subject of friction and delivered four Cantor Lectures on the subject in 1886. It was about this time that he invented his well-known multiple-disk clutch. He also became very interested in road transport, and in 1897 organized the Liverpool trials of commercial vehicles for the Liverpool Automobile Club and Self-Propelled Traffic Association. He became president of the Institution of Automobile Engineers in 1909.

After taking up consulting practice, Hele-Shaw developed several important inventions, among which his hydraulic variable-speed gear, the stream-line filter, and the Victaulic pipe joint are especially worthy of mention. His most recent important work was on variable-pitch airscrews.

As an organizer of technical education Hele-Shaw did valuable work, especially in more recent years in connexion with the introduction of National Certificates. In 1920, when the Board of Education approached the Institution of Mechanical Engineers with a view to collaboration in a certificate scheme to take the place of the old Science and Art Certificates, Hele-Shaw was chairman of the Education Committee of the Council, and it was largely due to him that the scheme was adopted. He was the first chairman of the Joint Committee and held this post until 1937.

Until the end he was a remarkably vital character. As a lecturer he was breezy, humorous, and unconventional, and as such will be happily remembered by more than one generation of students.

A. H. Gibson.

Sir Pendrill Varrier-Jones

By the tragically sudden death on January 30 of Sir Pendrill Varrier-Jones in his fifty-eighth year the medical profession has lost a pioneer in the full tide of his activities. The only son of Dr. C. Morgan Jones of Glamorgan, he was educated at Epsom College and St. John's College, Cambridge, where he was a foundation scholar and prizeman, graduating in the first class of the Natural Sciences Tripos, Part 1. Proceeding to St. Bartholomew's Hospital he qualified there and became house physician. On the completion of his term of office he returned to Cambridge for pathological research under Sir German Sims Woodhead. At the outbreak of the War of 1914-18 the Cambridgeshire tuberculosis officer joined the R.A.M.C., and Varrier-Jones, who was graded as unfit for military service, was asked to undertake his work temporarily. He accepted with some reluctance, for hitherto his interests had been directed purely to laboratory research.

It is difficult to realize to-day the total inadequacy of the treatment of pulmonary tuberculosis fifty years ago. Too often the out-patient at hospitals merely received some cod liver oil and cough mixture, after waiting for some hours at the risk of infecting other patients. Open-air sanatoria, both in Norfolk, were started in the middle 'nineties by Dr. Jane Walker and by Dr. Burton-Fanning. Then King Edward VII by his question "If preventible why not prevented ?" galvanized the authorities into some sort of activity, resulting in the establishment of the sanatorium at Midhurst. Though interest in the subject had now been aroused, no large-scale plans were made until the National Health Insurance Act, with the consequent provision of hospital and dispensary facilities.

The point on which Varrier-Jones seized was the great liability of the patient to relapse on his return to the environment in which he had contracted the disease, thus nullifying the efforts that had been made. Engaging the support of Clifford Allbutt, Sims Woodhead and Humphry Rolleston, he started a village settlement at Bourn in Cambridgeshire in 1915 with only one patient in a shelter, but filled with a vision of the future. That vision was for the patient to pass through all the stages of hospital and sanatorium treatment, and to be provided with occupation suited to his state of health. When afebrile he was to work at a trade for the trades union rate of wages. He would reside in a hostel, or if married, in the village settlement with his wife and family. If at any time his health relapsed he would be sure of prompt and expert treatment in the institution. And Varrier-Jones lived to see that audacious vision realized. In 1918 much more extensive premises were obtained at Papworth Hall, and gradually the institution expanded over five hundred acres of land, complete with administrative blocks, hospital wards, a large sanatorium, laboratories and a research institute, a village settlement of more than a hundred cottages, hostels for men and women, and factories with annual sales which together with those of Enham, have now reached nearly half a million pounds annually. This might have been considered sufficient for the activities of any man, but they were not enough for Varrier-Jones. He was honorary medical director of the Enham Village Centre for ex-Service men, replanned the Preston Hall Village Settlement at the request of the British Legion, and advised on the establishment of a village settlement near Dublin. His latest ambition was to add a teaching department to Papworth, and he was writing enthusiastically to some medical supporters about this only an hour before his death.

Enthusiasm was indeed the keynote of his character, reinforced by tenacity and tireless energy. He has been well described as a Celt with all the Celt's fire and imagination and with the long black hair and gestures of an impresario. In early life he was nicknamed the Pendragon, and he adopted this as the trade-mark of the Papworth goods. Sir Clifford Allbutt said of him that he restored hope to those who had lost it, and there is no doubt that his great success was due to the force of his personality. So individual were his gifts that it is difficult to see who can succeed him, for clinical insight and great business capacity are seldom united. Yet there can be no doubt that his plan is capable of wide extension and would greatly help to solve the problem of pulmonary tuberculosis, converting damaged lives from a liability to an asset for the community. He was strongly of opinion that the community by insisting on the notification of tuberculosis thereby accepted responsibility for those on whom it had imposed this handicap. It was his proud boast that no child born in the settlement of a tuberculous parent had ever developed tuberculosis.

The value of his work was publicly recognized by a knighthood in 1931, the fellowship of the Royal College of Physicians in 1934, and the Weber-Parkes Prize in 1939. W. LANGDON-BROWN.

Prof. V. Putti

PROF. VITTORIO PUTTI, the eminent orthopædic surgeon, who died recently, was born on March 1, 1880, at Bologna, where he received his medical education and qualified in 1903. For eleven years he was assistant to Alessandro Codivilla at the Rissoli Institute at Bologna, of which he became director in 1914. In 1909 he was appointed lecturer in orthopædics and in 1914 professor in this subject at his Alma Mater. In 1917 he founded the journal *Chirurgia degli Organi di Movimento*, to which *Bibliografia Ortopedica*, founded by him three years later, containing summaries of current orthopædic literature, formed a useful supplement. Putti introduced many new orthopædic operations and made numerous valuable contributions to the literature of his speciality, particularly on congenital dislocation of the hip, osteoarticular tuberculosis, for the electrotherapeutic treatment of which he founded the Codivilla Institute at Cortone d'Ampesso as a branch of the Rizzoli Institute, diseases of the vertebral column, transplantation of muscles and Madelung's deformity. Enjoying an international reputation, he received invitations to lecture in several foreign countries including Great Britain, where he had many friends. J. D. ROLLESTON.

WE regret to announce the following deaths :

Dr. Rendel Harris, F.B.A., the well-known biblical scholar, archæologist and Orientalist, on March 1, aged eighty-eight.

Prof. C. R. Lanman, professor of Sanskrit at Harvard University during 1880–1937, and a corresponding member of the British Academy, who was a distinguished Orientalist and authority on ancient Indian languages and literature, aged ninety.

Mr. C. A. Ludwig, associate plant physiologist in the Division of Soil Microbiology of the Bureau of Plant Industry, U.S. Department of Agriculture, on January 7, aged fifty-four.

Dr. Adolpho Lutz, for many years chief of the department of medical zoology at the Institute Oswaldo Cruz, Rio de Janeiro, aged eighty-four.

Dr. C. B. Ticehurst, the distinguished ornithologist and editor of *Ibis*, on February 17, aged sixty.

NEWS AND VIEWS

Mineral Nutrition of Plants

THE 1,000 dollar prize of the American Association for the Advancement of Science has been awarded to Dr. D. I. Arnon of the University of California for a paper read at the Philadelphia meeting of the Association on behalf of a seven-man laboratory team under the guidance of Prof. D. R. Hoagland. Since Prof. Hoagland's first experiments upon the mineral economy of Nitella—where it was shown that the growing cell swept most of the ions out of the surrounding medium, piling them up within its own sap, although thus doing work in accumulating them against the concentration gradient, whilst the mature or senescent cell indicates its advancing age by an inability even to retain or maintain this internal solute concentration—the workers in Prof. Hoagland's laboratory have rapidly established quite a new conception of the mineral nutrition of the higher plant. This has thrown a new light upon the high concentration of mineral ash in growing tissues and has thus made clear to agriculturist, and still more to horticultural and forest botanist, what large reserves of minerals may be available in adult regions of the plant, to be utilized over again after release and transfer from adult to growing regions.

Prominent in this work has been Dr. F. C. Steward, working first at the University of Leeds and later at Birkbeck College, London. In some of this work a technique has been employed with great success of introducing a new ion, bromine, and following the conditions governing its absorption and distribution. Dr. Steward has also shown, by his studies at the Tortugas, that the students of the salt accumulation of the large cells of Valonia cannot afford to neglect consideration of its growth phases or of the conditions under which it is maintained during the period of the experiment. He has also advanced our general knowledge of salt accumulation by his utilization of spectrometer methods which permit a rapid quantitative control of the rates of ionic interchange. Dr. Arnon himself has contributed particularly to our knowledge of the conditions governing the relative utilization of ammonium and nitrate sources of nitrogen; he has also been associated with a series of investigations upon the significance of relatively rare elements in plant nutrition, such as copper, zinc, manganese and molybdenum. Altogether, the work recognized by the American Association in this award represents a contribution which stands very high in the esteem of plant physiologists and in which the English contribution, associated with Dr. Steward and his collaborators, reaches the same high standard, both of experimental technique and critical interpretation.

Abyssinian Ornithology

THE invasion of Abyssinia and Somaliland has given members of the British army who are ornithologically minded a unique opportunity for observation in an area little explored by naturalists, and the outcome may prove as useful as the information noted by ornithologists stationed in Egypt in the War of 1914–18. Cheesman (*Ibis*, 1935) made a detailed survey of bird life in north-west Abyssinia, where he collected for the British Museum when H.M. Consul. The Abyssinian flappet lark, producing a rattle-like wing-sound when rising in song, is resident on the high plateau, the white-collared pugin, the great hammerkop and the African barn-owl nested at the British Legation at Addis Ababa. At Lake Tana there are black crakes, paaw bustards, egrets, buff-backed herons, a colony of white-bellied storks, spur winged geese, tufted duck, pochard, white-eyed duck, sea eagles, ospreys, marsh-harriers and lesser black-backed gulls. Wheatears are frequent passage migrants on the big grass plains, and these include the eastern black-eared wheatear.

The avifauna of the region includes many of its own forms as well as European birds on migration and rarer British species like the wood sandpiper and gull-billed tern, but there remains an enormous scope for field studies of bird habits in addition to compiling lists and skins. Cheesman obtained a new race of Cisticola or striped grass warblers at Wanbera, not previously visited by ornithologists, comprising a dozen species. Bird life is probably richest near the waters, like the Blue Nile and Lake Tana, with a wealth of waders, duck and fishing birds, but the colony of red-legged choughs at Simen is of considerable scientific interest, for the nearest colony to this is apparently at Cyprus. The Ethiopeans have never been greatly interested in their fauna, and although the chief dangers to bird life are the big fires, the protection of the larger insectivorous birds would no doubt help their agriculture against the locust and other pests.

Earthquake in Greece

ABOUT 5.55 a.m. local time on March 1, a severe earthquake shook many towns and villages in northern Greece. At Larissa, in Thessaly province, houses were destroyed, telephone and telegraph and other buildings damaged and some streets blocked by debris. Many people were frightened and left their houses. One person has been reported killed and five injured. Extensive damage was caused at Elassona, and the epicentre may have been near this place. The shock was also felt at Volo and Lamia, Kanditsa and Trikkala. In the whole district there may be as many as 15,000 people homeless as a result of the earthquake, although complete details are not available at the time of writing. Rescue work is being undertaken by the local authorities and by British soldiers and airmen.

The earthquake follows fairly recent earthquakes in Rumania and Cyprus. The epicentres of Greek earthquakes appear to bear some relation to the great lines of fracture to which the country owes its outline. Earthquakes are particularly frequent around the narrow gulf which separates the Peloponnesus from the mainland, and in the peninsula of Messene in south-western Greece, but in the past they seem to have been less frequent in the area now affected. It will be remembered that severe earthquakes took place in Greece on July 21, 1938, near Oropos, when about seventeen people were killed and eighty injured, and on April 17, 1940, near Patras, and Missolonghi, though on this latter occasion no casualties were reported.

Leadership

The Lees Knowles Lectures on "Generals and Generalship" delivered at Trinity College, Cambridge, in 1939, by General Sir Archibald Wavell and recently published in *The Times*, have now been reprinted and published as a pamphlet, with a foreword by General Sir John Dill (Times Publishing Co., Ltd., Printing House Square, London, E.C.4. *6d.*). Dealing essentially with the principles of leadership and the relations of man to man, they have an interest that extends far beyond military circles. Sir Archibald Wavell takes a quotation from Socrates as giving the best definition of the essential qualities of a commander, and agrees with him in placing administration first, while tactics or the handling of troops in battle comes last. Character, or knowing what he wants, with the courage and determination to get it, and a genuine interest in, and knowledge of, humanity come first in the moral qualities of a leader, while in the mental qualities, commonsense, or the knowledge of what is and what is not possible is the most important. The bearing of this analysis on problems of technical administration generally will be readily perceived, and Sir Archibald's remarks on the commander and his troops are equally suggestive and stimulating. There are many in industry who might well apply Sir Archibald's simple rules that a general should never try to do his own staff work, and that he should never let his staff get between him and his troops. Tradition and discipline, he holds, are the root of the matter in relations between the general and his men.

The third lecture, in which General Wavell deals with the relations of higher commanders with the statesmen who direct them, is in some ways the most significant in its suggestions for removing the friction between civil and military which tends to be a feature of democracy in war. Making the point that knowledge of the mechanics of war, not of the principles of strategy, distinguishes a good leader from a bad, and that both war and politics have been too highly specialized to be interchangeable professionally, Sir Archibald urges that a better understanding between the commander and the politician is essential for the conduct of modern war. The qualities which lead to excellence in generalship or in statesmanship have indeed much in common and should promote the thoughtful study of the past, the receptive mind and the patient understanding of each other's difficulties which are the key to mutual knowledge and understanding. General Wavell's lectures, which show all the lucidity of exposition and thought already apparent in his life of Lord Allenby, should do much to promote such understanding in all classes of our society, and enhance the confidence which we place in our present-day commanders.

Function of Treaties

Mr. A. D. McNair's admirable pamphlet "War and Treaties" (Oxford Pamphlets on World Affairs, No. 32. Oxford: Clarendon Press. *3d.* net) makes a most pertinent contribution to discussions on the new world order to be established after the War. In the poverty of international legal institutions, a treaty has to serve too many purposes, and this has largely contributed to the recent shocks to the sanctity of treaties and the shattering blows to the mutual good faith which lies at the very basis of our society. No principle of law has received such universal homage and is so widely spread as the rule *pacta sunt servanda*—agreements must be kept. Moreover, while a treaty can be violated not only by a clear breach or an unjustified denunciation but also by the much subtler means of a claim by a party to a treaty to be entitled to give it his own interpretation, once Governments have been led to refer a dispute concerning interpretation to an international tribunal, it is most rare for them not to carry out the decision. While the sanctity of treaties is a fundamental principle of international relations if force is to be excluded, treaties must contain within themselves the machinery for the revision of their provisions, or such machinery must be created outside them and be applicable to them. The problem of reconciling stability with means of peaceful change, of finding a mean between rigidity and flexibility, has, however, so far baffled international society and has been responsible for one crisis after another.

It is futile, Mr. McNair urges, to attempt to superannuate war unless we can substitute some peaceful machinery for achieving one of the common objects of war—changes in the *status quo ante*. That peaceful machinery, if it is to amount to more than revision by consent, must involve a willingness to accept the judgment of some kind of international tribunal or authority upon the equity of a claim, instead of insisting on being judge in one's own cause. Moreover, before the 'Family of Nations' can become a true society, some control must be placed upon the present licence in treaty-making. In view of the far-reaching danger to society which is implicit in a bad treaty, society must sooner or later acquire some kind of initial control upon treaty-making. Many treaties are more than the concern only of the contracting parties. The lack of any machinery for the supervision of treaty-making, and the paucity of rules upon the legality of treaties, are a serious defect in our present system. Commenting on the progress of the International Labour Organisation, Dr. McNair suggests that introduction of its practice of using non-governmental delegates, with the resultant encouragement of a more co-operative atmosphere, into a wide field of international affairs should make an important contribution to the development of a real international society by assisting the removal from international law of some of these imperfections and immaturities in regard to treaties.

Further Amendments to the Pharmacopœia

FURTHER amendments, due to conditions arising out of the prosecution of the War, have been made to the "British Pharmacopœia". They have been made effective by notices in the *Gazettes*. Owing to the closing of the principal source of supply of squill, namely Sicily, sanction is now given for the use of Indian squill (*Urcinea indica*) in place of *Urcinea scilla* in the preparation of oxymel, vinegar and tincture of squill. In the case of valerian, which was formerly obtained chiefly from Belgium, Holland and Germany, the use is now permitted of Indian valerian (*Valeriana wallichii*) in place of *Valeriana officinalis* whenever valerian is prescribed or demanded. Another amendment sanctions the use of sodium lactate instead of glycerin in the preparation of poultice of kaolin, the object being to assist in the conservation of supplies of glycerin. Facilities have been given by the appropriate Government departments for the importation of Indian squill and Indian valerian.

Institute of Chemistry

AT the annual general meeting of the Institute of Chemistry held on March 3, the president, Dr. J. J. Fox, C.B., the Government Chemist, presented the report of the Council, in the course of which he stated that the professional examinations of the Institute had continued, and the membership had increased by more than 220 during the year. The increase in the numerical strength of the Institute since 1914, he said, has been remarkable ; it has been multiplied more than five times, namely, from 1,454 to 7,775. In the meantime, unemployment among the members has never exceeded 3 per cent and at the present time is less than 1 per cent. Industry was far more fully staffed with chemists in September 1939 than in July 1914, but the Institute had been of much assistance to the Government in supplying chemical personnel during the War. Dr. J. J. Fox was re-elected president ; and the Meldola Medal for 1940 was awarded to Dr. E. R. H. Jones, assistant lecturer in organic chemistry in the Imperial College of Science and Technology.

Food in War-time

An important article, "Food in War Time", by Lord Horder in the *Quarterly Review* of January emphasizes the way in which food policy in war could be utilized to make a permanent contribution to national fitness, and the part which science has to play in pursuing this objective. Science, Lord Horder points out, supports a return to the diet that kept our fathers and forefathers fit, and assures us that in doing so we are on sound and rational lines. The memorial sent to the Prime Minister last May, of which Lord Horder was a signatory, urged that milk, potatoes, fresh vegetables, cereals, fats and sugar, should be kept constantly in mind as the basis of fitness. The whole consumption of the first three could be grown at home, and better use of our home-grown fruit would enable us to reduce considerably our imports of fruit. We could grow all the oats we need and much more of the wheat and barley.

A comprehensive food policy connotes close and constant co-operation between the Ministries of Food, Agriculture and Transport ; intelligent co-operation on the part of the consumer is essential to success in a campaign for feeding the people properly in war-time, and Lord Horder pleads for greater use of the educational opportunities given by war-time conditions. By planning wisely we could rapidly enable the town worker to retrace his steps in the matter of diet, making more accessible the wholesome foods which his ancestors ate and which he discarded when he became urbanized, and at the same time making less available the more unsuitable foods which have taken their place for the last two generations. In such planning the Minister of Food has the guidance and backing of science and medicine, and this contribution to building a better social and economic system could start now.

Merseyside Naturalists' Association

AT the third annual meeting of the Merseyside Naturalists' Association, held at the Liverpool Museum on February 23, Mr. R. K. Perry, keeper of vertebrates at the Museum, was elected president, Dr. J. C. P. Miller of the University of Liverpool, chairman, and Mr. Eric Hardy, honorary secretary. Since 1939 membership and funds have doubled, activities have been continued in full, with a well-attended programme of meetings ; additions to the local flora have been made to the national herbaria at Kew and the British Museum. The president exhibited a collection of skins of rare British mammals, detailed reports were presented of bird surveys at Leigh Flashes, Rufford, Puffin Island, the Great Orme's Head, Corwen, etc., and the MS. of the Association's proposed handbook on the birds of the area. As this is by far the largest natural history society in the area it was agreed to continue activities so far as the War permitted.

American Geographical Society: Medal Awards

Two medals have recently been awarded by the American Geographical Society. Dr. R. C. Murphy, of the American Museum of Natural History, receives the Cullum Geographical Medal for distinguished work on the migration and habits of oceanic birds, which are his speciality. He is the first ornithologist to receive this medal, which has previously been awarded thirty-five times. Earlier recipients have included Admiral Robert E. Peary, Sir John Murray and Prince Albert of Monaco. Prof. C. O. Sauer, of the University of California, receives the Charles P. Daly Medal, in recognition of his outstanding contributions to geography, especially in the fields of land classification and land utilization. Among the twenty-nine recipients of the Daly Medal have been Vilhjalmur Stefansson, Capt. Robert A. Bartlett and Dr. Roy Chapman Andrews.

Institution of Mechanical Engineers: Awards

The following awards have recently been made by the Institution of Mechanical Engineers: *Thomas Hawksley Gold Medal* to Dr. F. D. Smith and bronze replicas of the Medal to his co-authors, E. H. Lakey, H. Morgan, and C. A. Luxford, for the following papers which were presented as a group: "The Admiralty Cathode Ray Oscillograph Engine Indicator" by F. D. Smith, E. H. Lakey and H. Morgan; "Basic Principles in the Design of Cathode Ray Oscillograph Engine Indicators" by F. D. Smith; "Stress Measurement by Magnetostriction" by F. D. Smith and C. A. Luxford. *George Stephenson Prize* to Dr. R. C. Plumb and Prof. A. C. G. Egerton, for their paper on "A Criterion for Knock in Petrol Engines". *Dugald Clerk Prize* to G. W. A. Green for his paper on "Fuel Injection in Oil Engines in Relation to Combustion". *Water Arbitration Prize* to Dr. E. G. Holley for his paper on "The Static and Fatigue Torsion Strengths of Various Steels with Circular, Square, and Rectangular Sections". *Starley Premium* to Prof. W. T. David and Dr. A. S. Leah for their paper on "Fuel Economy in Petrol Engines". *Herbert Akroyd Stuart Prize* to Dr. G. F. Mucklow for his paper on "Exhaust-Pipe Effects in a Single-Cylinder Four-Stroke Engine", and R. W. Zdanowich and T. S. Wilson for their paper on "The Elements of Pendulum Dampers". *Thomas Lowe Gray Prize* to Prof. W. Kerr, Dr. J. F. Shannon and Dr. R. N. Arnold for their paper on "The Problems of the Singing Propeller". *T. Bernard Hall Prize* to F. Dollin for his paper on "Investigation of Steam Turbine Nozzle and Blading Efficiency".

An Active Sunspot

After several weeks of generally diminished sunspot activity, a large sunspot developed rapidly on the sun's disk between February 26 and 28. The spot was apparently associated with marked chromospheric activity on the latter date. The time of central meridian passage of the disturbed area was February 27·3.

Royal Society of Edinburgh: New Fellows

The following have been elected ordinary fellows of the Royal Society of Edinburgh: Dr. H. A. Cookson, Sunderland Royal Infirmary; Dr. C. A. Coulson, Mathematics Department, University College, Dundee; Mr. Atulananda Das, Imperial Forest Service, Shillong, Assam; Dr. J. N. Davidson, Biochemistry Department, University of Aberdeen; Prof. E. C. Dodds, Courtauld Institute of Biochemistry, Middlesex Hospital, London; Dr. E. Finlay-Freundlich, Department of Astronomy, University of St. Andrews; Mr. A. G. L. Gerard, assistant superintendent, Tongland Power Station, Kirkcudbright; Mr. J. C. Gibson, assistant secretary, Air Ministry, London; Mr. James Gray, 7 Spence Street, Edinburgh; Mr. R. L. Gwilt, secretary, Scottish Widows' Fund, Edinburgh; Mr. James Jamieson, engineer and manager, Edinburgh Corporation Gas Department; Prof. Mangalore Kini, Medical College, Andhra University, Vizagapatam; Mr. A. C. Marshall, director of education, County of Clackmannan, Alloa; Dr. A. G. Mearns, Department of Hygiene, University of Glasgow; The Hon Lord Moncrieff, senator of the College of Justice in Scotland, Edinburgh; The Hon. Lord Murray, chairman of the Scottish Land Court, Edinburgh; Dr. Ivan Parnell, Institute of Helminthology, Macdonald College, Quebec; Dr. E. G. V. Percival, Department of Chemistry, University of Edinburgh; Dr. F. E. Reynolds, pathologist to the Municipal Hospital, Glasgow; Mr. J. J. Robertson, rector, Royal High School, Edinburgh; Dr. A. D. Ross, Department of Civil and Mechanical Engineering, University of London; Dr. H. Scarborough, Department of Therapeutics, University of Edinburgh; Mr. A. Steuart, lately president, Royal Scottish Society of Arts, Edinburgh; Dr. R. L. Sutton, assistant professor of dermatology, Kansas Medical School, Kansas City, Missouri, U.S.A.; Dr. George Trapp, biology master, George Watson's Boys' College, Edinburgh; Dr. D. A. Walker, teacher of science, Daniel Stewart's College, Edinburgh; Mr. J. E. Wilson, senior research officer, Ministry of Agriculture and Fisheries, Edinburgh.

Announcements

Prof. James B. Conant, the distinguished organic chemist and president of Harvard University, who is a member of the U.S. National Defense Research Committee, is visiting Great Britain to confer upon collaboration in the scientific field.

Dr. L. J. Spencer, formerly keeper of minerals in the British Museum (Natural History) has been awarded the Roebling Medal of the Mineralogical Society of America.

The Swammerdam Medal for 1940 has been awarded to Prof. G. W. Grijne of Amsterdam, the Nestor of Dutch physiologists. The six previous recipients have been K. T. E. von Siebold (1880), Ernst Haeckel (1890), K. Gegenbaur and Hugo de Vries (1910), Max Weber (1920) and H. Spemann (1930).

According to a wireless dispatch to the *New York Times*, Prof. Paul Langevin, formerly professor of experimental physics in the Collège de France, who had been detained in prison in Paris, has been released on parole for reasons of health. Prof. Langevin was deprived of his professorship because of his political activities.

The Ministry of Agriculture is anxious to give every possible help to gardeners and allotment holders in the "Dig for Victory" campaign. The season for planting is just beginning, and it is of the first importance that the right crops be grown so as to avoid the production of surplus perishable summer vegetables. Plans made now mean plans for next winter, and adequate space must be allocated to the growing of the valuable potato, onion, carrot, beetroot and other crops that can be stored, and used as substitutes for foodstuffs that are normally imported. A suitable lay-out and cropping plan is given in Growmore Leaflet No. 1, which can be obtained free from most local authorities, while for more specialized information attention may be directed to Leaflets No. 32 on seed potatoes and No. 57 entitled "Tomato Growing is not Difficult".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Linkage between the Repeating Units in the Starch Molecule

IN an earlier paper[1] we presented evidence which indicated that the starch molecule is made up of a large number of repeating units (each consisting of an unbranched chain of some thirty glucose units) combined together in such a way that the free reducing group of one unit is linked glucosidically with a hydroxyl group of the adjacent unit. It is now apparent that in the derivatives of starch we have examined, the hydroxyl group concerned in the glucosidic union of the repeating units, is a primary alcoholic group situated at C_6 of one of the glucose residues. The occurrence of this mode of linkage was indicated previously[2] and was suggested simultaneously by Freudenberg and Boppel[3]. In this connexion it may be mentioned that we have never advocated the views on the structure of starch recently attributed to us by Kurt Meyer[4], and that, on the other hand, if each of the units represented in the formula suggested by Meyer is considered to contain some thirty glucose residues, his formula becomes identical in type with the structure we have advocated[1].

The new results are derived from the following experiments. Methylated rice starch was disaggregated[1], giving material of low molecular weight, specially suitable for experiments on the mode of linkage in that it readily undergoes complete methylation. On hydrolysis, the fully methylated derivative gives rise to 2 : 3 : 6-trimethyl glucose, 2 : 3 : 4 : 6-tetramethyl glucose (end-group) and dimethyl glucose. It is evident that one of the two free hydroxyl groups of the dimethyl glucose represents the point of junction of the repeating units. Examination of the dimethyl sugar has revealed that it consists almost entirely of 2 : 3-dimethyl glucose, from which it follows (since C_4 is involved in the linkages of the glucose residues within the unit) that the repeating units are connected through C_6 of one of the glucose residues. The yield of dimethyl glucose (3 per cent) is consistent with the view that one such linkage exists per repeating unit. The exact position of the particular glucose residue in the chain of the repeating unit is not yet known and the problem of its determination is of special importance in connexion with enzymic degradation of starch[5]. It is to be observed also that the present evidence concerns the linkages in the disaggregated derivative, and the further question, whether all the linkages connecting repeating units in the original starch are of similar type, must await further investigation.

The following evidence served to identify the 2 : 3-dimethyl glucose. (*a*) It forms both furanose and pyranose methyl glycosides, since in cold methyl alcoholic hydrogen chloride the rotation drops from $[\alpha]_D + 59°$ to $-30°$, and in boiling methyl alcoholic hydrogen chloride it rises to $+75°$. (*b*) The amide of the corresponding dimethyl gluconic acid gives a negative Weerman reaction with sodium hypochlorite. The hydroxyl at C_2 is therefore methylated. (*c*) The *p*-toluene sulphonyl derivative of the dimethyl methyl glucoside, when heated with sodium iodide in acetone at 100°, gave sodium *p*-toluene sulphonate (yield 87 per cent of the theoretical), and this was corroborated by an estimation of the iodine content of the syrup isolated after removal of the sodium *p*-toluene sulphonate. C_6 therefore carries a free hydroxyl group[6] and this, in conjunction with the other evidence, fixes the constitution as 2 : 3-dimethyl glucose.

The quantitative aspect of these results shows that other dimethyl glucoses cannot have been present in more than minute amounts, insufficient to affect the conclusions outlined above.

C. C. BARKER.
E. L. HIRST.
G. T. YOUNG.

The University,
Bristol.
Feb. 10.

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[1] Hirst and Young, *J. Chem. Soc.*, 1471 (1939).

[2] Bawn, Hirst and Young, Faraday Society Discussion, May 1940; *Trans. Faraday Soc.*, **36**, 881 (1940).

[3] *Naturwiss.*, **28**, 264 (1940).

[4] Meyer, K., *Helv. chim. Acta*, **23**, 880 (1940).

[5] Hanes, *New Phyt.*, **36**, 538 (1937).

[6] Method of Oldham and Rutherford for estimation of primary alcoholic group in sugars. *J. Amer. Chem. Soc.*, **54**, 366 (1932).

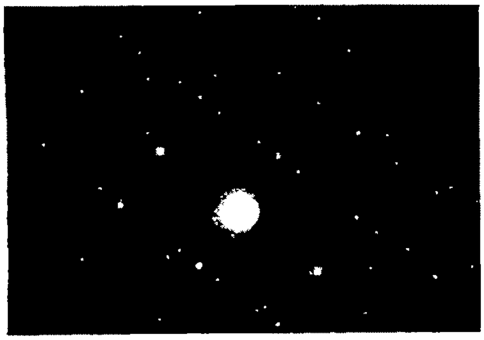
A New Method of obtaining the *N* Pattern of Electron Diffraction

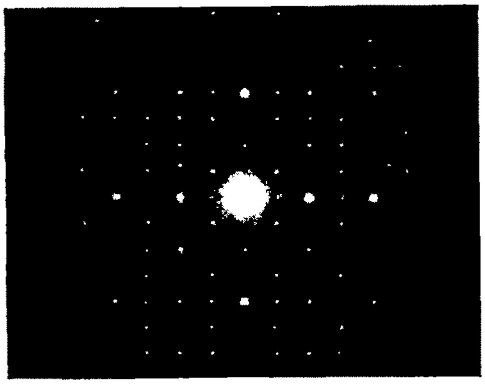
THE *N* pattern of electron diffraction was first obtained from a thin piece of mica. It has not been obtained for many substances because of the technical difficulty of preparing single crystal films of suitable thickness for electron penetration.

I have discovered a method of preparing two-dimensional films of various substances, and a big field of investigation by electron diffraction is now opened.

The *N* patterns shown in the accompanying photographs were obtained by the new method of preparation; the films, which may properly be called synthetic, are laboratory products and are made by allowing chemical reactions to take place under physical control.

Thin films of water or hydrochloric acid were first prepared by immersing a platinum wire gauze in water or in the acid (12 *N*) and then withdrawing it. Upon bringing such films into contact with a clean piece of potassium or calcium, chemical reaction immediately takes place, giving films of the reaction products adhering to the gauze and highly suitable for transmission electron diffraction experiments. The upper pattern is from a potassium bicarbonate ($KHCO_3$) single crystal produced by the method





described, the reaction being allowed to take place between potassium and water in the presence of air; the lower pattern is from a calcium chloride ($CaCl_2{\cdot}2H_2O$) single crystal similarly obtained but utilizing the reaction between calcium and 12 *N* hydrochloric acid.

The potassium bicarbonate crystal has already been studied by X-rays and the data serve well for comparison here. The dimensions of the reciprocal lattice determined by the *N* pattern here obtained are: $a^* = 15\cdot4$ A. and $b^* = 5\cdot72$ A.; X-ray work gives $a = 15\cdot01$ A., $b = 5\cdot69$ A., and $\beta = 104^\circ 30'$ (monoclinic structure). The new method of preparing films thus gives results in good agreement with X-ray findings.

As is well known, structure determination from the *N* pattern is more definite than that by X-rays, hence the present work is in this respect also of significance. Due to the highly hygroscopic nature of $CaCl_2{\cdot}2H_2O$, the determination of its structure has been beyond the scope of X-ray technique. I am working on its structure as given by the *N* pattern here obtained.

This work has been conducted under the direction of Dr. Ichirô Iitaká.

SHIGETO YAMAGUCHI.

Institute of Physical and
Chemical Research,
Tokyo.

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Dhar, J., *Indian J. Phys.*, 11, 187 (1937).

Magnetization of Matter by Light

ONE of us (F. E.) has shown that small particles of matter of different chemical elements, but of the same physical qualities, irradiated by concentrated light, move in a homogeneous magnetic field, some of them toward the north, some toward the south pole (magnetrode). Therefore, there must be a preponderance of either north or south magnetism on each of those irradiated particles, and they behave like single magnetic poles (charges)[1]. Further, experiment led to the conclusion[2] that, in addition to the oscillating electric and magnetic vectors, light beams must have electric stationary components in the direction of the wave front normal, and that consequently there must be stationary electric potential differences between different points along the beam; and that there must be also a stationary magnetic field in the beam of light with potential differences. Hence, the light beam must have a magnetizing effect, and the charge of a magnet should be changed by light.

Examination of the literature by the other of us (L. B.) showed that even before the time of Oerstedt's experiments, Domenico Morichini[3] (1812) magnetized compass needles by means of the ultra-violet portion of the spectrum of sunlight as used by Herschel. His experiments were verified by M. Sommerville[4], F. Zantedeschi[5], V. Baumgartner[6] and others.

We therefore undertook to test the photomagnetic effect also on larger bodies in continuation of the above-mentioned fundamental experiments on submicroscopic bodies (magneto-photophoresis), through which the general magnetization of the elements and the existence of magnetic 'currents' was brought to light. The experiments were successful with the simplest apparatus, undertaken in a private apartment with a 10 cent compass needle from Woolworths as indicator, and using a beam of light rich in ultraviolet radiation (Hanovia mercury arc, Mazda G.E. daylight bulb) which was concentrated by means of quartz lenses (Hanovia, Zeiss).

Magnetic poles (charges) were induced in various non-magnetic and annealed pieces of iron (paperclips, nails, little iron rods), which were placed perpendicularly to the geomagnetic field, by irradiation for periods varying from minutes to several hours. Those poles were mainly north magnetic and were still present in many specimens after several days.

After short periods of irradiation, it could be shown that the effect was local and on the surface. After long irradiation periods saturation values were obtained.

We also convinced ourselves by means of an amplifier and oscillograph of the Amplifier Company of America that the characteristic of an induction coil with an iron core changed under ultra-violet irradiation.

Naturally, the magnetization was also dependent upon the material, its surface and history to a very high degree. Further investigations are in process.

FELIX EHRENHAFT.
LEO BANET.

350 West 58th Street,
New York City.
Dec. 24.

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[1] Ehrenhaft, F., *J. Franklin Inst.*, 230, 381 (1940).

[2] Ehrenhaft, F., NATURE [146, 25 (1941)].

[3] Morichini, D., *Gilberts Ann. Phys.*, 43, 212 (1813); 46, 367 (1814).

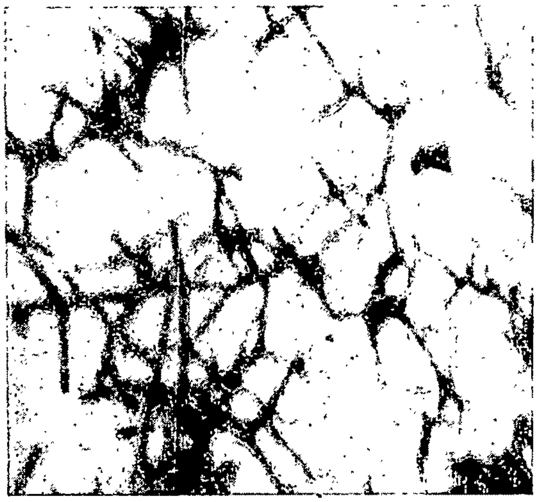
[4] Sommerville, M., *Gilberts Ann. Phys.*, 82, 493 (1826).

[5] Zantedeschi, F., *Gilberts Ann. Phys.*, 92, 187 (1829).

[6] Baumgartner, V., *Gilberts Ann. Phys.*, 85, 508 (1827).

Zinc Oxide Smoke

IN NATURE of December 21, 1940, p. 807, Mr. Fordham has referred to the shape of the particles of zinc oxide smoke, formed by burning zinc in air, as inferred from both optical and electron diffraction data. The accompanying photograph, obtained in this Laboratory by means of the electron microscope[1], confirms his statement that some of the particles are in the form of needles. The photograph shows that the small crystals of which the smoke consists are about 4,500 A. in length and not more than 450 A. in thickness. There is a remarkable uniformity in the apparent length of the crystals, although there is no reason to suppose that they all lie in one plane.



Zinc Oxide Smoke × 23,000

In the electron microscope we seem to have an instrument capable of yielding interesting information about the shape and size of smoke particles.

G. D. PRESTON.

Metallurgy Department,
National Physical Laboratory,
Teddington.

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[1] Martin, Whelpton and Parnum, *J. Sci. Instruments*, **14**, 14 (1937).

Weighing Living Marine Animals

I WAS interested in Dr. Gohar's recent communication on this subject[1].

Living marine animals were weighed by me some years ago and I am actively engaged in this work at Plymouth. The work has been interrupted by the War, and since I am teaching at Rugby I can devote the vacations to it only.

However, the accompanying figures were obtained for the common crab, *Cancer pagurus*, last vacation.

	Width of carapace in cm.	Weight in gm.	Volume in ml.	Density	Sinking factor	Percentage error by direct weighing
Male	10·13	145·08	126·77	1·1445	1112	+3·0
Male	10·5	174·01	142·50	1·2211	1187	+2·5
Male	15·5	630·64	498·58	1·2648	1230	+0·98
Female	11·21	185·53	165·01	1·1243	1091	+2·5

I left all the crabs alive in the aquarium.

By the term *sinking factor* one means the density of the living animal divided by the density of its environment, and to remove decimals the number is multiplied by 1,000.

After the crabs had been weighed accurately they were taken from the sea-water and drained for a minute. They were then transferred to a counterpoised clock-glass and weighed directly.

Though this has been the normal way of weighing a crab before the displacement method was devised, it is clear that with a small crab an error of 3 per cent may occur. With large crabs the percentage error naturally becomes smaller.

Though the work is only in its infancy a great many determinations of a similar character have been made on other animals. The method was fully discussed at a meeting of the Linnean Society and published[2]. A short account was also published in NATURE[3]. This work is being carried on with the aid of a valuable Government grant from the Royal Society and also help from the British Association and the Marine Biological Association.

Actually, Dr. Gohar's method was considered some years ago and discarded on account of the difficulties due to osmosis, since if one either dilutes or concentrates the sea-water one brings about considerable changes in the osmotic pressure of the environment, and one needs scarcely point out that changes in the osmotic pressure of the environment may have very far-reaching effects on the weight, volume, and hence the density of the animal.

This difficulty could be partly overcome by weighing the animal first in sea-water and then in an isotonic solution of sodium nitrate and calcium nitrate.

The displacement method is, however, far more accurate and straightforward and the question of osmosis does not occur, except that the osmotic pressure of the environment must be determined before the experiment.

In a good deal of the work I have had the cooperation of Dr. N. K. Panikkar, while together we have recently weighed a living lobster just after moulting, and determined the osmotic changes which occur and also the alteration in weight, and finally the percentage of water in a young lobster both before and after moulting.

A young dogfish is also being kept alive, and its weight and volume, density, sinking factor, and length noted each vacation.

A. G. LOWNDES.

The Science Laboratories,
Rugby School.

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[1] NATURE, **147**, 177 (1941).

[2] *Proc. Linn. Soc.*, Sess. **150**, pp. 62–73 (1938).

[3] NATURE, **141**, 289 (1938).

Science and Government

MR. FINLAY's letter in NATURE of January 25 reminds us that it is becoming the fashion in some quarters to claim for men of science special qualifications for administration in everyday affairs. This claim seems usually to be based on (*a*) the acknowledged power of the scientific method to demonstrate truth, and (*b*) the readiness of the man of science to accept truth so demonstrated.

Unrestricted experiment, which is a major feature of the scientific method, renders that method inapplicable in most of our everyday affairs; the well-being of a community cannot be hazarded by an experiment of which the outcome is not a foregone conclusion. Deprived of the discipline imposed by the power of the scientific method, can the scientist rely on his admittedly high professional integrity? Is not this professional integrity a tribute to the compelling power of the scientific method, rather than to the personal integrity of individual men of science? Is there any evidence that in ordinary everyday affairs the man of science differs from his fellows in the degree to which he is a prey to prejudice, obstinacy, and the other common human failings?

If we are deprived of experiment we must fall back on experience, that is, appeal to authority, which is admittedly less satisfying than scientific demonstration; and we cannot, as men of science lacking our chief weapon, expect to prevail in conflict with authority. We are fortunately able to examine a case of organized scientists studying a 'worldly' problem. In 1938 a committee of the Association of Scientific Workers produced a memorandum on the finance of research, being largely a plea for great expansion of research on the grounds that great profit would result. Unfortunately, the committee admitted that neither costs nor benefits of research are measurable, thereby denying the applicability of the scientific method. The memorandum was, therefore, much open to criticism, and finding itself in conflict with authority (the Department of Scientific and Industrial Research), inevitably succumbed.

If there is reason to suppose that scientific workers are not playing their full part in administration, the remedy seems to be that they should enter more fully into 'worldly' responsibilities and arm themselves with authority. There is no new principle, no breaking of tradition, in this; the purest scientist, most impatient of social restraint, is accustomed to publishing his work, thereby voluntarily taking cognisance of society. It is illogical, and therefore unscientific, thereafter to ignore society.

Finally, may I express complete agreement with the article on the cultural significance of science, in NATURE of December 28, 1940? If, by science teaching, we can produce a community schooled to logical and critical thinking, the problem of leadership may well solve itself. An unworthy candidate would less easily pass muster, while men of self-respect might be less reluctant to submit themselves as candidates. Is it too much to hope that some day we shall regard a School Certificate, with credit in mathematics and an exact science, as a minimum qualification for Parliamentary franchise?

E. C. CHILDS.

169 Hinton Way,
Cambridge.

MAY I be permitted as one of those who were expected to "render their own experience available for the vital task of foreseeing the threats to [the] great heritage of freedom and integrity of thought"[1], to express my view and apprehension concerning the current discussion in these columns about planning, freedom, and science. I think the communication of V. B. Wigglesworth[2] rightly points out that "scientists are human", and not better prepared for leading political positions than other people, and really the dispute about the motivations under which men of science work, or should have to work, shows most clearly that men of science themselves are often exponents of current political opinions, and the authority of 'science', called to witness, is only a fictitious one. With this in view the question whether freedom is in danger if men of science interfere in problems of government is very important indeed, and perhaps a retrospect on similar trends in Germany and Austria, about ten years ago, would not be without interest.

It is quite natural that planning, which is the demand of the hour, finds its strongest advocates among men of science. However, in my opinion a special cause of the decline of the democratic regimes in Central Europe was the ideology of the planned state, the *Stände-staat* (state of estates), which found its best supporters among the scientifically educated intelligentsia. So far as I know the study of this ideology, which was developed especially by Prof. O. Spann[3] in Vienna, and its great influence on the students in universities and technical colleges, has been neglected in the English sociological literature (for example, Mannheim in his book[4] does not mention them), although only by this knowledge can a true understanding of the ideas of the so-called educated people during the rise of fascism be attained, and similar mistakes in the existing democracies prevented. The exponents of the idea of the *Stände-staat* were the scientific experts, the men with a specialized scientific education. Fascinated by planning, and eager to find a secure place in a new hierarchy of society, those men paved, often unaware of the consequences, the way for fascism. Scientific experts are by the whole structure of their present one-sided education easily inclined to become exponents of planning merely for the sake of planning, to follow authoritarian creeds, and so to open the way for political powers which bring in peril not only political freedom, but the freedom of science itself. I cannot help feeling that the political claim of men of science for 'science' in Great Britain and in the United States involves the same idea of organizing 'science' as a special estate, a form of political organization which is incompatible with democracy, and which may become a danger to it.

To propose that men of science should desist from any public activity would certainly be to take a short view. The way of propaganda, however, proposed as a means of enlightening the people about their real benefactors seems only to open the door for pseudo-science, on which ground very strange ideas might develop. Is there no other way open to men of science than to become politicians, no direct approach to help humanity and to bring about the much-quoted new and better world? Of course, there is one, namely co-operation with a liberal and humane educational work, the supreme task of the longed-for state of liberty *and* planning. Here is a task especially for the pure scientists in universities, who, I am afraid, in the existing democracies neglect this part of their professional work, as have done the democratic professor-specialists in the German universities.

OTTO BLÜH.

University of Birmingham,
formerly of
German University of Prague
Feb. 26.

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[1] NATURE, 143, 179 (1939).

[2] NATURE, 147, 119 (1941).

[3] Spann, Othmar, "Der wahre Staat" (1923).

[4] Mannheim, K., "Man and Society in an Age of Reconstruction" (1940).

RESEARCH ITEMS

Celtic Linch Pin

A FINE enamelled linch pin, British work of the early first century of our era, which was found at King's Langley, Hertfordshire, in 1937, has now been added to the British Museum collections. It is figured and described in *Brit. Mus. Quarterly*, 14, 4 (1940). It is 5·1 inches in length and has a shank of iron with bronze terminal mounts. That on the head is a splendid crescentic ornament inlaid with a red enamel. The pin itself has a creamy-green putina. The scroll pattern of the field is conventionalized almost to the ultimate stage of transformation into geometric, but this in no way detracts from the fluent gracefulness of Celtic art. The contained design is exactly adjusted to the sweeping contour of the head. What is at first sight a central circular medallion is really the spiraliform volute of a scroll, with asymmetric manipulation of detail to give the effect of a fold-over symmetry—an achievement in which Celtic artists took special delight. This is illustrated in a number of pieces of about the same date, one of the most notable examples being the Desborough Mirror, also in the Museum collections. The linch pin recently has been described as "a late and eccentric version of the type that was introduced into Yorkshire by the Parisii in the mid-third century B.C."

A Classification of Birds

THE earlier edition of his revision of the "Classification of the Birds of the World" (1934) having become exhausted, Alexander Wetmore has published a new edition (*Smiths. Misc. Coll.*, **99**, No. 7; 1940). There are relatively few changes in the new grouping: the fossil forms Baptornis and Apatornis have had special families allocated to them, and among the Anseres is included a new family, Paranyrocidæ, for a fossil from the Lower Miocene of South Dakota. Instead of associating the osprey Pandion with the Cathartæ, as L. V. Compton suggested, Wetmore follows the more conservative plan of placing Pandionidæ in the superfamily Falconoidea, considering that the resemblances between the ospreys and New World vultures, upon which Compton placed emphasis, are more likely due to convergence than to genetic relationship.

Geographical Distribution of Opalinid Infusorians

IN his latest study of the opalinid ciliate infusorians, which revises and extends a previous U.S. National Museum Bulletin on the group, Maynard M. Metcalf describes thirty new species and sub-species, and traces with high probability the course of the evolution of the family, unifying facts derived from comparative anatomy, development and geographical distribution in proving "the phylogeny beyond reasonable doubt" (*Proc. U.S. Nat. Mus.*, **87**, 465–634; 1940). In addition, he sets an example to the specialist by deriving from his detailed studies information of great general interest. Thus he has plotted on maps the distribution of different opalinid genera and species, and has associated this knowledge with the distribution of their hosts in an effort to trace the places of origin, the times of origin, and the routes by which hosts and parasites arrived at their present-day dispersal. The general result is that the data derived from opalinids and anurans fit harmoniously with the hypotheses of palæocartographers, such as Arldt and Schuchert, regarding the relationships of land masses in the past, the only discrepancy being that the opalinid facts seem to demand a connexion between Asia-Malaysia and Lemuria during the Jurassic or early Cretaceous periods. The author concludes that the Pleistocene glacial period came too late to be of much significance in connexion with the evolution and distribution of the Anura and their opalinids, most of the evolution of both having taken place long before Pleistocene times.

New Zealand Dobson-fly

AVICE HAMILTON has recently described the life-cycle of the common New Zealand Dobson-fly (*Archichauliodes diversus* Walk) (*New Zealand J. Sci. and Tech.*, 23, A; 1940). This insect, it may be added, is the only member of the suborder Megaloptera in New Zealand and is closely related to the single Australian species *A. guttiferus*. The eggs are deposited in irregular masses on rocks and trees that overhang streams, and the incubation period is about 30 days. The larva is aquatic and each of its first eight abdominal segments bears a pair of unsegmental conical filaments containing branched tracheæ. These filaments are evidently gills, and respiration is stated mainly to be effected by diffusion through their cuticular covering. There are in addition ten pairs of spiracles, but whether these are functional or not is unstated. The food of the larvæ consists mainly of the nymphs of may-flies that are plentiful in the streams that they inhabit. Both prepupal and pupal instars are described. The imago, which is a relatively large insect, lives only six to ten days and has not been observed to feed. The species occurs commonly throughout the country and is often abundant in localized areas. The larvæ serve as food for trout and other freshwater fish.

Soils and Afforestation

AT the request of the Forestry Commission, Muir and Frazer have carried out a soil and vegetation survey of an area of diverse geology some forty miles to the north-west of Aberdeen, which is undergoing afforestation. With the aid of H. M. Steven the results of this investigation have been presented (*Trans. Roy. Soc. Edin.*, **60**, No. 8; 1940), in association with a statement of the current views, on the basis of the Commission's experience, on the choice of tree species suitable for planting on the different soil types in the given climatic conditions. Soils of the podzol group are represented, derived in general from the more acid (geologically) parent materials; the basic igneous rocks give usually soils of the 'brown earth' type. No correlation is observed between the depth of the bleached horizon of the podzols and the rainfall. Grassland is the more frequent vegetation in the 'brown earth' soils; but in the district generally heath and moorland types prevail, dry heath on the acid soils, wet heath and moorland on the soils derived from the heavier basic rock materials.

Inversions in Tradescantia

C. R. SWANSON (*Genetics*, **25**, 438–465; 1940) has shown that a hybrid population of Tradescantia resulting from the natural hybrids of *T. canaliculata* and *T. humilis* contains a considerable number of inversions in the chromosomes. There is a high correlation between number of interstitial chiasmata and number of inversions. This is taken as evidence that interstitial inversions are numerous but are usually undetected where the chiasma-frequency is low and localized. With hybridity, genes controlling pairing at meiosis recombine and may induce pairing of parts of chromosomes which otherwise were isolated. Pairing in chromosomes of Tradescantia begins at the distal end of the chromosomes. The phylogenetical aspects of the data are discussed and it is shown that self-incompatibility favours gene recombination, while inversions and chiasma localization act as barriers to recombination. Where self-sterility genes lie close to inversions they tend to aid the perpetuation of inversion heterozygosity.

Spontaneous Chromosome Change

C. D. Darlington and M. B. Upcott (*J. Genetics*, **41**, 297–328; 1941) have analysed spontaneous structural alterations in the chromosomes of Tulipa Hyacinthus and Tradescantia. In many respects these changes are similar to those induced by X-ray radiation. It is therefore possible to discuss the reasons for the diversity of the results of such changes. For example, the frequent occurrence of small acentric rings, attributed to two breaks initiated by one hit, are more probably the result of two breaks followed by preferential union between non-sister chromatids. Similarly it is probable that the diverse results of induced exchange are due to the diversity in the conditions of reunion. Further, reunions between broken ends of sister chromatids and sometimes between non-sister chromatids may take place many cell generations after breakage. The experimental dosage frequency of changes and fractionation effects are therefore interpreted by the competition in types of reunion and not by the frequency of types of break initiated by a hit. The authors also point out that the new interpretation emphasizes that chromosome splitting is uniform and takes place late in the intermitotic resting stage.

Thermal Conductivity of Rocks

KNOWLEDGE of the thermal conductivity of the materials of the earth's crust and its dependence upon temperature is required for the quantitative treatment of numerous problems of geology and geophysics. F. Birch and H. Clark (*Amer. J. Sci.*, **238**, 529; 1940) describe an apparatus for the measurement of conductivity between 0° and 500° C. and present results for 18 igneous rocks, 7 sedimentary and metamorphic rocks, 3 single crystals and 4 glasses. At 0° C. the conductivities of all of the rocks lie between 0·014 and 0·004 in C.G.S. units; at 200° C. all lie between 0·009 and 0·004. The conductivities of the poorest conductors, the felspar aggregates and the glasses, increase with temperature, whereas those of all the other crystalline materials decrease. The highest conductivities are found for the ultrabasic rocks, hitherto unstudied, but here, as with other rocks, the variation is such that the values tend to converge as the temperature increases. While the differences are important at the temperatures at which measurements of geothermal gradients are made, they become much less so at depths within the crust of the order 10–20 km. A simple method of computation permits a calculation of the conductivity of fresh igneous rocks in terms of their mineral composition with an error usually less than five per cent at temperatures up to 200° C. This method may prove useful in the discussion of gradients and heat flow in rocks the conductivities of which have not been measured. An interesting example is a gradient of 144–170 metres/° C. in a Russian occurrence of pyroxenite and peridotite; from this the heat flow may be estimated at about $0{\cdot}8 \times 10^{-6}$ cal./cm./sec., in fair agreement with the results of Benfield in Britain and Bullard in South Africa.

Stereochemical Types and Valency Groups

THE Bakerian Lecture by N. V. Sidgwick and H. M. Powell (*Proc. Roy. Soc.*, A, **176**, 153–180; 1940) deals with stereochemical types and valency groups, and illustrates the advantages of having alternative ways of grouping the same set of facts. Experiments on X-ray and electron diffraction, absorption and Raman spectra, optical activity and electrical dipole moment have produced data of interest to both physicist and chemist. So far, the treatment of the results in theoretical physics has linked up the stereochemistry of the molecule with the number of shared and unshared electrons in the polyvalent atom, and the electronic sub-groups which these occupy. Unfortunately for the chemist, when the energy differences between the various possible electronic arrangements, or between various stereochemical groupings which are compatible with the same electronic structure, are small, they cannot be determined by calculation. Thus, possible instead of actual arrangements are predicted. Furthermore, the chemist cannot always tell whether the bands in a given molecule are *s*, *p*, or *d*, even when this is clear to the physicist. An attempt is therefore made to relate the data to some property of the molecule with which the chemist is more familiar. The arrangements in space of the covalencies of a polyvalent atom, while they are subject to small variations, seldom exceeding 5° or 10°, tend to conform to quite a limited number of types. By using the size (in G. N. Lewis's sense) of the valency group of the central atom, and the number of shared electrons which it contains, together with that of the preceding (unshared) electronic group in the atom, the authors are able to fit the experimental results into eight relationships (see NATURE, July 13, 1940, p. 70). The bibliography at the end of the paper covers fifteen pages.

Flame Spectrum of Carbon Monoxide

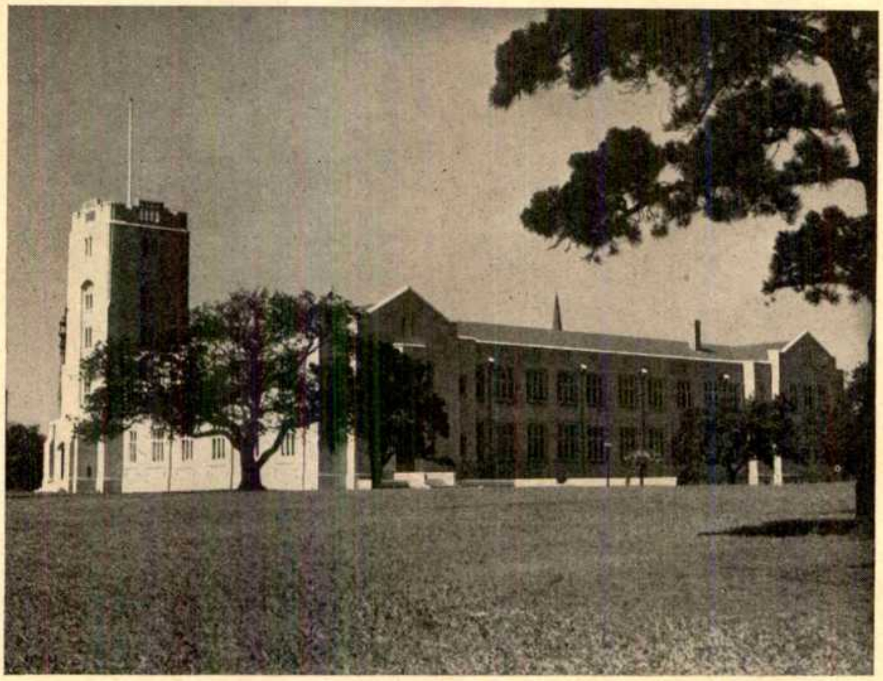
APART from the complexity of the spectrum of the flame of carbon monoxide burning in air or oxygen, great difficulty has been found in interpretation because of the weakness of the bands relative to the continuous background. The results of an improved technique have been reported recently by A. G. Gaydon (*Proc. Roy. Soc.*, A, **176**, 505–21; 1940). Whereas previous workers had used relatively fast photographic plates with low contrast, plates of the highest contrast were used in the present investigation. The improvement in contrast has enabled new measurements of the spectrum to be made, and the structure of the band system and its origin are dealt with in the light of the more recent developments in knowledge of molecular structure.

THE AUSTRALIAN NATIONAL STANDARDS LABORATORY

BY SIR DAVID RIVETT, K.C.M.G.

COMMONWEALTH COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

WITH the help of the Department of Scientific and Industrial Research, a plan for a Standards Laboratory in Australia was drawn up in 1927, to be controlled by the recently created Council for Scientific and Industrial Research. Unfortunately, the need for it was not fully realized in political circles until, after ten years or more, the growth of secondary industries and an impending acceleration due to war activity, made further postponement obviously dangerous.



AUSTRALIAN NATIONAL STANDARDS LABORATORY, SYDNEY

Rapid progress has been made in the past eighteen months and a handsome building has now been completed on a site generously provided in its grounds by the University of Sydney. The front (eastern) elevation is faced with white Hawkesbury sandstone to fit in with the general architectural scheme of the main frontage of the University; the sides and back are treated with light-coloured brick and stone trimmings.

With two stories and a basement in front and three stories and basement behind, the total floor space available is 80,000 sq. ft. Besides laboratories and test rooms for the usual three sections of metrology, electro-technology and physics, there is adequate provision for general offices, workshops and a library. Many of the rooms, including a 130-ft. tape tunnel, are air-conditioned, the plant being designed to maintain a temperature of 68° F. ± 1° at bench height.

Particular attention has been paid to the problem of means to run special electrical or other services from one room to another. Vertical ducts to every alternate room and horizontal ducts along the external walls serve this purpose. In addition, numbers of 2-in. diameter pipes have been embedded in the reinforced concrete floors to provide passage between rooms on opposite sides of corridors.

The laboratory will hold all national standards for the Commonwealth and will, of course, maintain intimate contact with the National Physical Laboratory at Teddington, which during the past two years has extended its hospitality to some nine officers for purposes of general experience in the calibration and use of instruments. It is the intention to establish substandards laboratories, under State Government control, in certain of the capital cities, to carry testing work beyond the stage to which it will be taken by the National Standards Laboratory.

Considering existing difficulties in obtaining equipment, the Council has been fortunate in securing the instruments and workshop machines which are now in its possession.

The building, which cost £100,000, will for the present house certain other activities of the Council for Scientific and Industrial Research in physics, as well as the normal standards services.

COLOUR TOLERANCE

ON February 12, the Physical Society Colour Group held its inaugural meeting at the Regent Street Polytechnic, London. In accepting the responsibility for the formation of this group, the Physical Society hopes to provide a valuable opportunity for people interested in colour, whether as physicists, chemists, dyers, industrialists or otherwise, to meet for their mutual benefit. A number of societies have already agreed to co-operate by becoming founder societies of the group and, in addition to the Physical Society, these include the British Kinematograph Society, the Illuminating Engineering Society, the Institute of Physics, the Royal Photographic Society, the Society of Glass Technology, the Society of Dyers and Colourists, and the Oil and Colour Chemists' Association.

The opening meeting was in part occupied by a discussion of the constitution of the Group, but when this had been formally adopted, a discussion on "Colour Tolerance" was held. Such a subject presents a very wide field, and was chosen intentionally for the opening meeting so as to interest as many people as possible and to provide an opportunity for each type of worker to become acquainted with the others.

In a brief introduction, it was shown that the problems of colour tolerance can be divided roughly into three, namely, the commercial aspect, in which the requirements of the customer have to be considered, the technical aspect, in which the limitations of manufacturing processes have to be taken into account, and the physical aspect, in which the specification and measurement of colour tolerances must be discussed.

Mr. R. F. Wilson, of the British Colour Council, in dealing with the commercial side of the problem, showed how valuable it is to limit the number of colours employed in any particular industry to the minimum that will satisfy the general public. In this way manufacturing costs can be very materially reduced and the irritating task of trying to differentiate between colours that in fact possess only minute differences, can be avoided. Remarkable figures for the number of colours that were used until recently in various cases, as, for example, in stockings and in the dyeing of the soles of ladies' shoes, were quoted during the discussion. Mr. Wilson also referred to the importance of the lighting on the accuracy to which colours can be matched, and appealed for more uniform lighting conditions. He instanced the case of a firm that has an excellently equipped viewing room and yet often encounters difficulties because the very perfection of its lighting arrangements is so different from that employed by the retailer. The question of a standard daylight lamp was raised by several speakers, while it was also pointed out that for many purposes, of which theatre lighting and interior decoration may be cited, artificial lighting is more important, so that a standard artificial lamp is also very desirable.

A point raised by Mr. Wilson and echoed by other speakers was the often serious trouble that arises when persons with defective colour vision are employed in colour industries. Colour-blindness may be regarded as a somewhat extreme case; but it is evident that even slightly abnormal vision may affect the ability of an observer to detect small colour differences correctly.

Mr. H. W. Ellis, of the Clayton Aniline Co., dealt with the technical limitations of dyeing processes and in his paper he demonstrated how the limits to which the dyer should be asked to work ought to be determined very closely by the purpose to which a dyed material is to be put. A material may sometimes have to be made fast to light, sometimes to washing, sometimes to the effects of perspiration and so on, but only in exceptional cases would the expense of using a dye fast under all conditions be justified. Thus while curtain material should be fast to light, this is of little importance in the case of ladies' underwear, which must, however, be made fast to washing.

Again, it may happen that the colour of a surface varies according to the direction in which it is viewed, and when several different viewing angles are presented simultaneously, as for example with hats, it becomes important that the change in colour with angle should be held within close limits. Samples were also shown to demonstrate the change in colour that results with given changes in the chemical conditions of dyeing; but perhaps the most striking feature of Mr. Ellis's paper was the evidence it afforded that tolerance questions may arise in many and varied forms.

Mr. J. W. Perry, of Messrs. Adam Hilger, Ltd., had the task of discussing the physical aspect of colour tolerances. He indicated how tolerances can be expressed in the standard C.I.E. chart or, if desired, on an oblique projection of the chart known as the rectangular uniform chromaticity scale (R.U.C.S.), and then developed equations from which the tolerance, defined initially in terms of the additive primaries of the C.I.E. system, can be transformed into the terms of the subtractive primaries of the dyer. One of the greatest difficulties, and one of the greatest opportunities, for the Colour Group, will be to bridge the gap between the additive colour mixture familiar to the physicist and the subtractive colour mixture always employed by the dyer. This is unfortunately a by no means simple matter and it has the, to the dyer, added disadvantage of requiring a fair amount of mathematics. Mr. Perry did not spare the chemists and dyers, and later in the meeting urged that each member of the Group should be prepared to make the mental effort required to understand the approach of other members to the problems of colour. At the same time, those taking part in the discussion must bear in mind that many of their audience have been trained along very different lines from their own and they, too, should make an effort to express themselves in the simplest possible manner.

It was inevitable that at the opening meeting a number of points would arise that had little direct bearing on colour tolerance, and it was especially interesting to notice how frequently references to colour-blindness occurred, suggestions being made that a test for colour-blindness should be instituted in schools. The effect of eyestrain when using instruments, the sensitivity of the unaided eye in detecting small colour differences compared with the sensitivity when a colorimeter is employed, the mathematical developments of colorimetry in the United States, the merits of spectrophotometers, all came in for some comment. The excellent attendance, the interest of the members and the wealth of material as subjects for discussion, augur well for the future of the Group.

ELECTRICALLY DRIVEN SHIPS

In war-time, while the question of capital cost is not the most important consideration, anything which increases the tonnage of the Navy and of the merchant fleet deserves serious attention. During the War of 1914–18, the attempts of the German Navy to blockade the British Isles by the unrestricted use of the submarine presented a similar problem. It was solved by the adoption of entirely novel methods. In addition to methods of speeding up ships of conventional design, the so-called 'fabricated' ship was constructed, and bridge builders and constructional engineers were called in to help. The parts of the hull were constructed, usually inland, and were sent to a convenient location on the coast where they were erected and launched.

In the *Electrical Review* of January 24, Mr. A. Regnauld makes a useful contribution to the solution of the problem by pointing out that ships' output can be increased by increasing their speed. This can be done by utilizing the large available electrical manufacturing industry for the production of the propelling machinery, and leaving the shipyards to deal with the production of the hulls.

In present circumstances, the manufacture of electric generating equipment is largely in abeyance and so also is the production of prime movers. If the shipyards could increase the output of hulls, the propelling equipment for the additional vessels could be constructed in its entirety by the electrical manufacturers and associated boiler manufacturers when steam turbines are installed. In all modern turbo-driven steamships, some form of speed-reducing gearing must be employed. The most efficient propeller speed for merchant tonnage, namely, 12–15 knots, is 100–120 r.p.m. The economic speed of the steam turbine is very high, somewhere about 3,000 r.p.m., varying according to size. Neither the turbine nor the heavy-oil engine can be readily reversed. This involves the use of specially constructed turbines running in the reverse direction to the main turbines. These astern turbines are often of sufficient size to develop more than 50 per cent of the ahead power. They may only be required for half an hour or so, at the beginning and end of a voyage when manœuvring out of and into port. This represents a very uneconomical effect.

With the electric drive, particularly if two or more generators are employed to supply the maximum power, a very high degree of flexibility is obtained at all the different speeds used in service. If bridge control be fitted, it would prove of supreme value in any emergency which might arise. The maintenance charges comprised of overhauls and repairs are generally in favour of the electrically driven ship.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Saturday, March 8

Society for Cultural Relations with the U.S.S.R. (at the Royal Hotel, Woburn Place, London, W.C.1), at 1 p.m.—Prof. George Thomson: "Anthropological Theory in the U.S.S.R."

Monday, March 10

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 5 p.m.—Mr. Gerald Seligman: "The Structure of a Temperate Glacier".

Tuesday, March 11

Chemical Engineering Group in conjunction with the Institution of Chemical Engineers (Joint Meeting) (in the Rooms of the Chemical Society, Burlington House, Piccadilly, London, W.1.), at 2.30 p.m.—Mr. E. W. Murray: "Ventilation (Natural and Artificial) in relation to the Blackout".

Illuminating Engineering Society (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 2.30 p.m.—Addresses on "Recent Work on A.R.P. Lighting Problems."

Wednesday, March 12

Geological Society of London (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Annual Meeting. Prof. P. G. H. Boswell, F.R.S.: Presidential Address—Part 1: "The Status of Geology, a Review of Present Conditions"; Part 2: "The Stability of Minerals in Sedimentary Rocks".

Friday, March 14

Royal Astronomical Society (at Burlington House, Piccadilly, London, W.1.) at 3 p.m. Annual General Meeting. Professor H. C. Plummer, F.R.S.: "The History of the Vertical Telescope."

North-East Coast Institution of Engineers and Shipbuilders (in the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. J. Calderwood: "Some General Observations on Vibration".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer for Mechanical Engineering Subjects—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1 (March 17).

Demonstrator in Biology—The Principal, Technical College, Kingston-upon-Thames.

Assistant Professor of Metallurgy—The Director, Department of Mining and Metallurgical Engineering, Laval University, Quebec City, Canada.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Finance and the War. An Address given by Prof. F. Soddy to Members of the Parliamentary Labour Party at the House of Commons on Tuesday, November 9, 1940. Pp 16. (London: Economic Reform Club and Institute.) 3*d*. [291

Report on Conditions in Reception Areas. By a Committee under the Chairmanship of Mr. Geoffrey Shakespeare, M.P. Pp. 18. (London: H.M. Stationery Office.) 3*d*. net. [291

Tin Research Institute. Publication No. 102: Hot-Tinning; an Account of the Tinning of Steel, Iron, Copper, Brass and Bronze by the Hot-dipping Process. By Dr. C. E. Homer. Pp. 28. (Greenford: Tin Research Institute.) [291

Other Countries

Publications of the Alleghany Observatory of the University of Pittsburgh. Vol. 8, No. 5: Observations of Eros, 1930–1931. By N. E. Wagman. Pp. 63–76. (Pittsburgh, Pa.: University of Pittsburgh Press.) [291

Government of Bengal: Department of Agriculture and Fisheries. Report on a Survey of the Fisheries of Bengal. Pp. iii + 88. (Alipore, Bengal Government Press.) [291

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POPULATION PROBLEMS AND EDUCATIONAL POLICY

UNDER present conditions in the Western World we are faced with a decline in the population which shows every sign of attaining serious dimensions over the coming decades, a decline unparalleled by anything that has happened in human history before. The decline will be most strongly felt in Scandinavian countries, in the white portions of the British Empire, among other nations of Western Europe, and in the United States ; but there is every indication that as time goes on it will extend to all parts of the earth. affecting every race and colour. Opinion may be divided over the immediate causes which have led to the fall in the birth-rate below replacement level. It is significant, however, that it has come about first among those nations which have been foremost in the discovery and application of science. It is significant, too, that the decrease in births has occurred in countries where living standards are higher than elsewhere, so that it can have no relation to the problem of mere survival in any Malthusian sense, and its explanation must be sought in the complex of economic organization and personal ideals which help to make up the present social order.

This decline in the reproduction rate of certain peoples is not without its tragedies. In recent years, for example, the Jews in Central Europe have been limiting their births more severely than the nations among whom they have been living. With whatever eyes we may look upon the persecutions and indignities to which they have been subjected, and the efforts made to transport them from one place to another, if left in peace their numbers would have shown a marked falling off even in a generation's time, and the decline might well have been progressive. Similarly, as we watch and take part in the magnificent fight which the British Empire is putting up against the Totalitarian Powers, we cannot escape the realization that in a few decades' time, the democratic nations will be considerably weaker in effective man-power than they are now. Victory will have been dearly bought if its fruits sink below a rising tide of superior numbers in other parts of the world. If the British people are to continue as a world power, in any sense of the term, it is imperative that a positive demographic policy should be put into practice, and soon rather than late.

Nor are the problems which a declining birth-rate brings upon us restricted to the international field. Great and almost more pressing ones face us at home. It was among the wealthier classes that the practice of family limitation first came to be adopted. This may prove to be a temporary phase ; but while it continues it results in a situation in which the greater part of the next generation is recruited from the lower strata of society, and from those who with the largest families have the greatest struggle to provide the barest essentials of life in the form of food, nursing care and house room. Whether such a state of affairs will lead to any disgenic results, and so produce another type of national decline, is still a moot point. From the pioneer work of M'Gonigle, Orr, and now of many others, it is abundantly clear that the poorer sections of the community, even in normal times of peace, if members of families with several dependants, are cramped in their health and physical development, not to mention those intellectual and cultural influences which civilization should confer. To see that such people receive sufficient for their full physical development would not be an increased burden, but a wise and beneficial investment, which would reveal itself in the improved effectiveness of the nation, whether on the battlefield, in the factory or in the home. Alternatively, the wealthier and professional classes, with more house room and easier standards of life, are not reproducing their numbers; they are not, therefore, bearing their full share in the production of the future British nation, which their higher living standards, their richer cultural environment, and, in some cases at any rate, their superior intellectual endowments should lead us to expect.

Here we are face to face with the crux of the whole problem. At the present time, parents of the wealthier classes have stronger inducements to restrict their families than any other section of the community. They live in an environment in which child-bearing is unpopular, nursing and medical care is expensive; the parent has to see his child through long years at preparatory and public schools, and then at the university, before finally having to produce the capital to see his son launched successfully on a professional or business career. On a proportionate but lower scale the cost of producing and educating daughters is also formidable. While such a state of affairs continues—and it is not easy to visualize any early remedy—the idea of a small family will be extremely difficult to overcome, and since social codes spread from above downwards, it seems likely to affect all grades of society until a considerable amount of social reconstruction has been carried through.

At this stage in the demographic progress of the nation it is interesting but disquieting to observe how acquiescent public opinion and even our intellectual and political leaders are in a situation which, if left to itself, may develop into a national calamity. The reason for this cannot be due to lack of information, for the facts as outlined above have been available for some time past to all readers. The prevailing impression appears to be that some fall in the population of Great Britain would be welcome, and that in the long run things will right themselves. One or two economists have directed attention to the prospects of decreasing markets, and to shifts in consumer demand, but their discussions have borne the impression of being mainly theoretical and of no immediate moment. On the other hand, signs of a change in social emphasis are beginning to appear. The scheme for cheaper milk to children and mothers, under which in certain circumstances it can be provided free, although introduced to alleviate the severity of war-time rationing, is a step in the right direction. A more considerable one would be the introduction of a national scheme of family allowances, particularly if its scales were made elastic enough to cover all social grades. Support for the idea of family allowances is growing perceptibly at the present time, but the Government has announced in the House of Lords that the Government cannot find the necessary funds for such a scheme during the War. Curiously enough, opposition to family allowances comes more from the ranks of organized labour, where their effect would be most beneficial, than from those who would have to bear the extra budgetary cost.

So far, the fall in the child population has passed almost unnoticed by health and education authorities, for it has led to concealed, but none the less real, economies in buildings and staff. It has been among the public schools that the fall in recruitment has begun to show itself in the form of actual financial stringency, as well as in empty boarding houses. Among the public schools the decline in numbers has gone so far, having been aggravated by the War, that the Headmasters' Conference has taken the matter up, and the Board of Education is being sounded to see what assistance may be forthcoming from the State. Since discussions are still proceeding it is impossible to forecast what may emerge. Judging from what has appeared in the Press, there are indications that efforts will be made to retain the boarding-school principle, while extending the scope of entry through some form of public assistance.

All such proposals are purely short-range and empirical in character. Although they may contain the seeds of a genuine demographic policy, they are not looked upon in that light by those who have brought them forward. In fact, we have to realize that demographic problems have not yet reached the arena of practical politics anywhere in the British Empire, whether we are thinking of the white people whose numbers are about to decline, or of the coloured races who, under British rule, are multiplying so rapidly that with them Malthusian conditions actually or very nearly apply. Social distress in the West Indies, in India, too, and empty cradles in Great Britain are complementary evidence that to the great majority of our leaders no demographic problem is thought to exist. Such conditions point to the vast field of social welfare and betterment that is waiting to be taken up.

In approaching this field, however, the only line promising any kind of permanent success lies through education, particularly through the application of those biological principles which may be termed human biology. What is envisaged is a reorientation of social and personal ideals, so that individualism and money standards no longer hold full sway. The public schools, for example, must come in for a good deal of reconstruction. Founded as most of them were when children were plentiful, and when women in consequence were accorded a low status, they have accentuated the separation of the sexes and imposed a monastic mode of life upon the boys as well as upon the staff. Through their character training they have extolled the ideal of masculine individuality. The leadership principle is the antithesis of co-operative work involving all kinds of people and both sexes. From now on, leadership to be at all effective as a social force must involve responsibility for rather more children than with other grades of society. Such questions as these have been elaborated in greater detail in a memorandum on "Human Biology and the Crisis in the Public Schools"[1] issued recently by the Educational Advisory Board of the British Social Hygiene Council. The memorandum merits careful consideration by all who are concerned with the future of the British nation, as well as by those primarily interested in the educational policy of the public schools.

If entry to the public schools is to be widened to maintain numbers, one immediate result may be to intensify the desire in parents to limit their families. To counteract such an influence, in granting its assistance the State should impose conditions calling for reforms in teaching practice and educational aims. For the future it will be necessary to inculcate the idea that girls and women are true partners in life of boys and men, that many of the finest rewards in life, its tenderest emotions and greatest personal satisfactions lie in the home. Sex must be freed from its associations of false sentimentality and furtive pleasures, and made the subject of rational thought and conduct. This should make for greater happiness in providing a more natural framework for human activities and desires, tending to reduce many of the frustrations which now bear so heavily upon society.

In bringing about a new orientation of social standards it is very probable that educational practice will lag behind political expediency, for educational policy is nearly always conservative. The State will have to assume the role of a true parent to its children. To achieve this, the present system of financial rewards in the shape of wages, salaries and profits may need to be modified in keeping with a more co-operative form of community, in which returns bear a closer relation to the biological responsibilities of individual members. As indicated above, a bold scheme of family allowances would make a big difference. Social and economic rearrangements of this nature would not be in any way subversive, for they would make for a stronger and a healthier nation. They would also provide a bulwark for democracy, for once the principle of family limitation is recognized, the task of bearing children is one of the last that public authorities will be able to impose upon private individuals. The true source of democracy is the home, and it is from healthy and well-satisfied homes that the future members of the British nation must eventually come.

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[1] Educational Advisory Board, British Social Hygiene Council, Tavistock House South, Tavistock Square, W.C.1. Gratis.

THE MYSTERY OF RUST

The Corrosion of Iron and Steel

Being a General Account of the Work of the Corrosion Committee of the Iron and Steel Institute and the British Iron and Steel Federation. By Dr. J. C. Hudson. Pp. xv+319+43 plates. (London: Chapman and Hall, Ltd., 1940.) 18*s*. net.

THE late Sir Robert Hadfield made a hobby of collecting statistics about steel, including the loss caused by corrosion; he mentioned at a time when the world slump was at its height that the destruction due to corrosion that year was probably greater than the total production of new steel. He might well have added, what are we chemists and metallurgists doing about it?

For many years the only remedy was paint: the painting of the Forth Bridge has been described as an eternal circle of operations. When I was a student, G. T. Moody propounded a theory on what happens when iron rusts, which promptly brought forth a rival one from Wyndham Dunstan: engineers were aghast at the temerity of chemists in interfering with the normal happenings of Nature, and were not surprised that the chemists failed to agree. Forty years on, and the bad old times when iron rusted are giving way to the new age of rustless alloys, official committees of investigation, some understanding of the problem, and a considerable amount of first-class research.

It is estimated that the annual cost, including labour, of protecting the iron- and steel-work in

Great Britain amounts to £40 million: in the United States 120 million gallons of paint per annum are applied to ferrous metals. It is obvious that a minute percentage on these bills would provide very large sums for research, and it may be asked why the world is not sufficiently enlightened to-day to insist on such a levy. In the days to come the world will not be able to afford to let iron rust at this rate.

Something, however, is being done, and it is the purpose of Dr. Hudson's book to tell the story of the Corrosion Committee. It was formed in 1928 under the chairmanship of Dr. W. H. Hatfield; it has representatives of producers and scientific workers and the direct support of industry both in kind and through the industrial research laboratories. It is one of those typically British volunteer organizations in which the spur is the love of the cause and the reward is the fact that something has been accomplished. Such a team requires above all leadership, and whether he functions as coach or stroke, Dr. Hatfield has given clear proof that he can provide this. Financial help is provided by the Department of Scientific and Industrial Research, by the Admiralty, Lloyd's and the British Steelworks Association: it is inconceivable that such a cause should be short of the necessary funds. There is similar work in hand abroad, mostly looked after by co-ordinating committees, and the book gives a short note about the activities in six countries, the most important being the United States. Needless to say, there is, or was, close international co-operation in these matters.

An iron plate rusts in a single night by chemical action, the jute fibres of a sandbag are rotted within three weeks in hot weather by bacteriological action: clearly the affinity of iron for oxygen is very great. Any investigation must discover the factors causing rusting and the possibility of their removal. To prevent rusting, both the resistance of iron and steel to rusting and the means of protection against rusting must be improved. These are the essentials of the problem. How are they to be tackled?

The late Prof. H. E. Armstrong tried to train his engineering students on the detective problem, "What happens when iron rusts". Put bluntly, they resented being taught chemistry in this way, being "forced to think" as he said, and wanted to have facts thrown across the lecture table, which they could catch and throw back in the examination. Perhaps engineers have been too ready to accept the fact that iron rusts and adopt a fatalistic attitude to the phenomenon.

The problem of rust must be tackled from the point of view of the shape of things to come, which is week by week being developed in the editorial columns of NATURE. Rusting is as much as anything due to the pollution of the air in our cities: let us therefore have clean air. This can largely be effected by legislation: the people need clean air just as much as iron does. Let us have clean air just as we have clean water: the opposition of the interests who would have us burn raw coal must be swept away. The politicians play with the things the mass mind can grasp, and the big problems that matter are left for the most part to find their own solution in the efflux of time. Surely science can make the mass mind grasp the need for clean air.

Steel can be rendered almost entirely resistant to rusting by suitably altering its composition, but this is costly—too costly in fact for other than special application. Nickel costs £200 a ton, and only 113,000 tons were produced in 1937: there must be more nickel produced at a much lower cost—a monopoly, if there be one, must disappear, for it is not in the public interest.

The book is a general summary of the first ten years' work of the Corrosion Committee and describes it in very readable form. If a reviewer is entitled to skip and turn to the end, as some people do with a detective story, then we may turn to Chapter xi, where what has been accomplished is set out clearly and succinctly.

The positive results fall under two heads. One is the development of low-alloy rust-resisting steels, largely carried out across the Atlantic, which has enabled the resistance of structural steel to rusting to be doubled. The other is a multitude of improvements in painting procedure. Even more important probably is the far greater understanding of the problems, both generally and in detail, which will ensure future progress being much more rapid.

The possibilities of low-alloy steels are immense; their development waits on the elaboration of methods for their fabrication, but these are rapidly forthcoming. Protective coatings of greater durability, involving the use of synthetic plastics as paint components, also promise to give better and cheaper maintenance.

Great progress has been made with special steels for the chemical and oil-refining industries, which must have these and can afford to pay the price for them. Here, as always, there is a race between demand and accomplishment.

Iron rusts in the air, under the ground and in the sea; this is its nature. Man needs bridges in the air, pipes under the earth and ships at sea; he must face the challenge how to make them last longer. In the long run, the effort is one of trained brains, helped by time and money. We can see to it that the training is not lacking and that the right men are given their chance to achieve.

E. F. ARMSTRONG.

EMPIRICISM IN METAPHYSICS

The Nature of the World

An Essay in Phenomenalist Metaphysics. By W. T. Stace. Pp. vii + 262. (Princeton, N.J.: Princeton University Press; London: Oxford University Press, 1940.) 18*s.* 6*d.* net.

THE book which bears this ambitious title is an essay in metaphysics on a phenomenalist basis. As was to be expected, the course of the inquiry leads the author to discuss most of the problems of philosophy. This fact may perhaps excuse any tardiness in this notice of the work, for it would be a poor compliment to the writer to offer an impression gained after a hasty reading. After two careful readings of this book I can say that, though I still disagree with the method and many of the conclusions, it is in my opinion one of the most important contributions to metaphysics which have appeared in recent years.

Prof. Stace is a thorough-going empiricist, at least in intention. The point where argument would break out is precisely whether the intention has really been fulfilled. Has any material been used in the construction which is not, in the strict sense, derived from experience? It seems to me that there is an *a priori* element in the metaphysical construction, and that it comes in at the place where Leibniz suggested that the *a priori* must be introduced when he added to the formula of empiricism "Nihil in intellectu quod non prius fuerit in sensu," the phrase "nisi intellectus ipse".

However this may be, Prof. Stace conceives the purpose and method of philosophy in a thoroughly empirical and 'scientific' manner. The proper method of philosophy is, in his opinion, that of hypothesis. "An hypothesis is put forward regarding the nature of the concrete. An attempt is then made to show that this hypothesis 'explains' the known facts about the world. Finally, reasons are given why this hypothesis should be preferred to others which equally explain the facts." It should be added, however, that by 'explain' Prof. Stace means very much what science means by it, and not the finding of reasons for things or answers to the question 'why?'. It will be seen that Prof. Stace renounces the kind of insight which many philosophers have sought—one which would grasp the world as a rational whole and would find that in the end reality and value were reconciled.

The central concept of this metaphysical construction is that of the cell. The hypothesis put forward is that the universe is a plurality of cells, all of which are of the same fundamental structure. Nothing exists except cells. Though the metaphysical conception of cells is, of course, suggested by the biological, it has properties which differentiate it from any scientific hypothesis. A metaphysical cell is absolutely indivisible. It is not material nor is it spiritual; it is the concrete reality of which matter and spirit are abstract aspects. Every cell consists of two parts, consciousness and datum, and cells differ in the quantitative and qualitative characters of their data. No doubt the hypothesis thus baldly stated has a paradoxical air, but its working out is calculated to remove the prejudices of common sense.

Naturally, Prof. Stace realizes that his theory has a resemblance to Leibniz's philosophy of monads, and it must be added that one of the most startling of Leibniz's assertions concerning his monads is repeated by Prof. Stace about his cells—they do not interact, they "have no windows". Leibniz felt that the appearance of interaction deserved at least some explanation, and he devised, to meet this need, his famous theory of the "pre-established harmony". Prof. Stace feels no such need; sufficient for him that in fact the cells do so function and develop that they appear to be interacting, that there is "cellular correspondence". It seems to me that other readers as well as myself will consider this cellular correspondence an odd feature of the world for which they would like an explanation, but Prof. Stace would reply that we were searching for what we cannot have—reasons.

It would be interesting to touch upon some more topics on which Prof. Stace has invited argument, He maintains that all consciousness is thinking, and that there is no such thing as will. In order to carry out this hypothesis, he has to employ the notion of "submerged concepts". Again, on the subject of values, he contends that the validity of value judgments and their universality has nothing to do with the "so-called objectivity" of values. This is a discussion which deserves attention.

I cannot think that what Prof. Stace has to say on religion and the reality of God is quite on the level of the rest of his book. He has perhaps not allowed himself sufficient space, and it may be hoped that he will devote a separate volume to the philosophy of religion.

W. R. Matthews.

UTILIZATION OF CHEMICAL LITERATURE

Chemical Productions
Their Nature and Use. By Prof. M. G. Mellon. (International Chemical Series.) Second edition. Pp. xii+284. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 18*s*.

IN spite of the fact that during the last decade there has been an enormous increase in chemical literature, Prof. M. G. Mellon has been able to retain substantially in its original form the classification evolved in the first edition of this work. As the author's desire is to provide a text-book for an undergraduate course in chemical literature, this classification is based rather on the nature of the publication in which the information appears than on the nature of the subject-matter. Thus, in the first place, he divides the literature into publications containing new material or new presentations and discussions of known material, designating these "Original Sources (Unorganised Information)"; publications containing information compiled from an original source arranged according to some definite plan, which he designates "Secondary Sources (Organised Information)".

Under the heading "Original Sources" there are four subdivisions, namely, periodicals, contributions of institutions, literature on patents, and miscellaneous contributions. "Secondary Sources" are subdivided into periodicals and serials, bibliographies, general works of reference and text-books, and miscellaneous compilations.

A separate chapter is devoted to each sub-class, and, apart from general descriptions of each type of chemical literature, a great deal of useful information will be found. For example, lists are given of journals available on general science in the different countries of the world, together with a note of the standard abbreviations used in citing references to the periodicals. In the same way general chemical journals are listed in chronological order of appearance. These include the earliest journals available, and all the more important later ones, the list being of particular interest in that it indicates the length of life of these publications.

Current journals which are mainly devoted to specialized branches of chemistry are classified under the headings used in *Chemical Abstracts*. In this case titles were selected by some one interested in the particular subject, and accordingly the list embodies the more generally useful periodicals classified under thirty different headings.

There are included in the book in addition many valuable suggestions leading to a greater understanding of the potentialities of chemical literature. Whether the student is concerned with patent searches, abstraction of journals, the compilation of bibliographies or some specialized research in the chemical literature, he will find it helpful and time-saving to follow the general principles laid down by the author.

Finally, in order to stimulate actual contact with the publications in question, there are appended a number of study sheets or library problems relevant to certain sections of the book. These, it is suggested, might provide the basis of a practical library course in chemical literature.

CORN GROWING IN THE OLD DAYS

Corn Country
By C. Henry Warren. Pp. viii+136+34 plates. (London: B. T. Batsford, Ltd., 1940.) 10*s*. 6*d*. net.

CORN growing in Great Britain falls roughly into three periods: the open field period from early times up to the end of the eighteenth century; the craftsman period which attained its highest development during the years 1850 to 1880; and the modern period in which science and machinery dominate, and which set in about 1890. The countryside now shows little but vestigial remnants of the open field system, but memories of the craftsman period still linger among the old men, and form part of the background of our village life. Happily, various modern writers have discovered the literary value of English country life, and a considerable number of books are being written about it; some by those who have actually gone through what they describe, such as Fred Kitchen, a farm worker with a natural gift for writing; others by men who have explored farms and villages to note down what they could see and hear.

Mr. Warren's book belongs to this second group: he has succeeded in putting together a very interesting account of the first two periods. For the story of the open fields he has gone back to some of the old records and has reproduced pictures from the well-known Grimani and Louterell psalters.

But the greater part of the book is an account of the craftsman period as remembered by the older men, and tinged by the mellow light that, fortunately for human beings, suffuses past recollections and softens their harsh features.

Space does not permit of quotations from some of the talks with old men so fully recorded. But all aspects of corn growing in the old days are attractively dealt with, even to the straw plaiting done by the women and children, and the innumerable patterns of braiding and thatching evolved in the different districts. In spite of its unpromising appearance as a plastic material, the country folk of those days succeeded in working straw into very attractive forms. There was much pride in high farming, and it seems clear that the workers extracted a good deal of satisfaction out of what appears to us to have been a trying life. The illustrations taken from Pyne's "Microcosm" (1822) suggest no hint of hard times—and yet it is certain that they were hard.

The author barely touches the modern period, and then only to condemn it. All the scientific work on the nutrition of the wheat plant, the breeding of improved varieties, and the diseases and insect pests of crops; all the engineers' efforts to make machines for the more rapid execution of the work of sowing and harvesting the crop, and the labours of the economists to find some basis for arriving at the cost of growing it—all this and much more is passed over in a few sentences. The use of nitrogenous top dressings is condemned, although a full-sized picture of a man broadcasting sulphate of ammonia is given. Clearly the author hankers after the craftsman period as seen by those looking back. But he does not explain why the craftsman period came to an end, nor does he suggest any course of action for the perplexed farmer struggling to keep his men on the land and to pay them the statutory minimum weekly wage in addition to the various extras; nor does he show how to meet the chronic shortage of farmyard manure, or to obtain seed of the old varieties of those halcyon days. No explanation is offered as to why, in spite of efforts of Governments and County Councils, the numbers of small holdings shrink, and the possibility of subsistence farming which so much appeals to the author becomes more and more remote. The plain fact seems to be that in spite of the attractiveness of the age of craftsmanship to some members of the intellectual classes, the actual workers prefer the age of science and machinery.

As one expects from the house of Batsford, the illustrations are well chosen and beautifully executed.

E. J. Russell.

PRINCIPLES OF THE REPRODUCTION OF SOUND

Elements of Acoustical Engineering
By Dr. Harry F. Olson. Pp. xv+344. (London: Chapman and Hall, Ltd., 1940.) 30*s*. net.

Dr. H. F. Olsen is in an authoritative position for dealing with the subject of acoustical engineering, and his book will be specially useful to those concerned with acoustics from the point of view of the engineer. It is well written and freely illustrated, and may be understood by anyone familiar with elementary physics and simple electric circuit theory.

The major portion of the book deals with the theory, design and testing of apparatus for the reproduction of sound. Early chapters describe fully the fundamental principles used in modern acoustics, and develop the analogies between electrical, mechanical and acoustical systems. Later chapters describe current acoustical practice in connexion with radio, gramophones, motion pictures and public address systems, and give very full accounts of the characteristics of various forms of microphone, 'pick-up' and loud-speaker.

The treatment of the various aspects of acoustical reproduction is comprehensive, and the fact that Dr. Olsen is speaking mainly about matters of which he, himself, has made a special study possibly explains why more than one quarter of the references in the book are to his own works.

On some general aspects of acoustics Dr. Olsen's treatment is naturally less comprehensive. The review of the subject of speech, music and hearing is a brief one. Supersonics is regarded as outside the scope of the work. On the instrumental measurement of noise, the book describes certain tentative American standards, suggested in 1936, in which a microphone is used in connexion with an amplifier of earlike frequency characteristics and a square law detector. No mention is made of the findings of the international conference held in Paris in 1937, which failed to accept such a standard, or to more recent developments in the objective measurement of noise. However, architectural acoustics and its measurements receive useful notice, especially in relation to the use of reproducing systems in auditoriums.

In brief, the book is to be recommended to all interested in modern acoustics, especially to those concerned with engineering aspects of the recording and reproduction of sound.

Applied Chemistry for Engineers

By Dr. Eric S. Gyngell. Pp. viii+328. (London: Edward Arnold and Co., 1940.) 15*s*. net.

THIS small volume presents in a particularly happy manner an account of many materials used by the engineer and the processes by which they are made, or in which they are used. There are no lengthy tables of analyses or detailed accounts of laboratory methods, but, instead, general descriptions and careful explanations of many terms, such as, for example, 'gas coal', 'cetane number', 'differential aeration' and 'continuous blowdown', with which the engineer is probably familiar, but might have difficulty in defining.

More than half the book is devoted to fuels and combustion, but in view of the fact that the subjects dealt with are, among others, the nature of fuels, gases and their manufacture, the distillation and synthesis of liquid fuels, methods of combustion and thermal calculations, this cannot be considered excessive.

Forty-nine pages suffice for a comprehensive account of the principles underlying corrosion and its prevention, while the remaining chapters deal briefly with paints, water treatment, cements and lubrication. So brief are these that at first sight they would appear scarcely worth inclusion, but careful scrutiny reveals the fact that the author's gift of condensation is such that very few salient points have escaped notice. A little more information about modern paints would be valuable, and perhaps a future edition will contain a chapter on plastics.

This notice would not be complete without reference to the 135 diagrams, which combine small size with remarkable clarity. Finally, although the book is written for engineers, it should be read by every student of chemistry who wishes to acquire an insight into something more than the purely theoretical side of his science. H. E. W.

A Textbook of Dietetics

By Dr. L. S. P. Davidson and Ian A. Anderson; with Diet Sheets constructed by Miss Mary E. Thomson. Pp. xviii+324. (London: Hamish Hamilton Medical Books, 1940.) 10*s*. 6*d*. net.

THE unprejudiced reader will cordially endorse the appreciation of Sir John Orr, the director of the Rowett Institute for Research in Animal Nutrition, Aberdeen, when he says in the foreword of this book that the practitioner will find in it not only precise and detailed guidance for dietetic treatment, but also a scientific and lucid account of the recently acquired knowledge on nutrition on which such treatment is based. The book, which is based on courses of lectures on the physiology of nutrition and the practice of dietetics given for several years to students in the University of Aberdeen, is divided into five parts. The first consists of a general survey of the nation's diet, past and present, with special reference to the diet at various levels of income, and the experimental, clinical and sociological data on the relation of diet to health and fitness. The second part contains a clinically complete account of the physiology of nutrition. Much of the material in this section (particularly on the vitamins) is based on very recent experimental and clinical studies. The third part is devoted to diet in health, including problems of diet in childhood, pregnancy, lactation, training and war-time. In the fourth part the dietetic treatment of established diseases is discussed. The fifth part consists of tables, recipes and diet sheets, the last of which have been constructed by Miss Mary E. Thomson, sister-dietitian to the Royal Infirmary, Aberdeen.

A bibliography of recent and almost exclusively British and American literature is appended.

The eminently practical and up-to-date character of the work renders it a most desirable addition to the library of a medical man.

Diseases of Poultry

Their Aetiology, Diagnosis, Treatment and Control; with a Section on the Normal Anatomy and Physiology of the Fowl. By Ernest Gray. (Lockwood's Agricultural and Horticultural Handbooks.) Pp. x+198+16 plates. (London: Crosby Lockwood and Son, Ltd., 1940.) 9*s*. 6*d*. net.

VERY few veterinary surgeons have thought fit to write a book on diseases of poultry. Mr. Ernest Gray has done justice to the subject and is to be congratulated on his effort. A book of this size, written by one with specialized knowledge, will add to the value of any library or private bookshelf.

Naturally a good deal of the reading matter is dry and somewhat unappetizing, but this is unavoidable in a book of this character. The section dealing with specific poultry diseases is more readable than the chapters on anatomy, physiology, pathology and feeding. The book is exceedingly well illustrated and the illustrations should prove of great value to the novice when desirous of getting to the 'root of the evil'. The author makes frequent references to writings by American workers, and also refers to some recent work by British specialists.

The book would appear to fill a place between the cheap British publications on this subject and the expensive but comprehensive works recently published in the United States. H. HOWES.

Garden Science

By Dr. John Grainger. Cheaper edition. Pp. 265. (London: University of London Press, Ltd., 1940.) 2*s*. 6*d*. net.

THE re-issue of this work at such an astonishingly low price will be welcomed by all those who are familiar with the earlier edition. It is designed to meet the needs of amateur gardeners, horticultural and agricultural students, as well as pupils of matriculation standard. Characteristics of seed and vegetative propagation, plant growth and its control by the gardener, problems of plant sterility and of pest and disease control are discussed, while considerable prominence is given to descriptions of methods used for raising improved varieties of plants, the planning of experiments and of educational gardens.

tion is to be seen to-day. This consists in a replacement of surface by overhead applications, water being supplied to plantations by powerful pumps at the rate of 3,500 gallons a minute. The actual distribution is effected by rotating overhead nozzles or projectors, possessing an effective radius of about 70 yards, that is, each projector sprays approximately three acres (Fig. 1). The tall 'risers', that is, vertical 5-in. pipes which convey the water up to the projector nozzles, are spaced throughout the plantation as required (Fig. 2). The complete equipment, comprising a power house, two large pumps, 14-in. mains, submains and laterals, thus represents a very considerable mechanical intrusion into the leafy greenery of a banana plantation. The results achieved have been very satisfactory. As to the working method, overhead irrigation is applied continuously for several hours at a time; the duration of each application is such as to provide the equivalent of several inches of rain, thus achieving the effect of a heavy, sustained, tropical precipitation. From a point of vantage the spectacle presented by the system in operation is quite remarkable, the great arcs of water, slowly swinging round, gleaming in the bright sunlight, or being resolved into miniature rainbows.

It need scarcely be said that such extensive projects have been the subject of careful costings. Notwithstanding the initial capital expenditure, the results obtained, as judged by increased production of fruit, decrease in labour costs, etc., have been such as to justify the experiment, and the system is being extended. Factors which require consideration include the fertility and probable duration of production of the area, the status of Panama disease (*Fusarium oxysporum cubense*) and its liability to rapid spread, and the proximity of adequate water supplies for pumping.

Overhead irrigation has not only proved successful as a commercial venture, but several important results, probably not anticipated, have also accrued. Not least is the fact that this method of supplying water has greatly facilitated agricultural operations on heavy clay soils, effecting, it is thought, an actual improvement in the tilth over a period of time. Further, it has made it possible to utilize for banana cultivation soils of much higher clay content than had hitherto been deemed possible or advisable. This is a very important consideration, since clay soils have not only proved productive of good fruit, but are also 'resistant' to the inroads of Panama disease. To what extent the conquest of clay will eventually be extended by overhead irrigation, in conjunction with other innovations, is a question that cannot fail to command the attention of all interested in tropical agriculture. It will suffice to say that a high standard of production is to-day being obtained on clay soils which twenty years ago would have been omitted from any well-considered planting programme.

A characteristic of the cultivation of the Gros Michel on heavy clay soils is that the initial growth tends to be somewhat tardy, so much so that planters may be induced to think that their venture has been ill-advised and destined to failure. Experience has shown, however, that if fertilizers are applied during the first few months, the initial lag is greatly reduced; plants improve progressively with age, especially after the foliage canopy is established, and consistently good yields may be obtained. Such detailed attention to potentially productive areas is now part of the working policy of the larger companies and is in sharp contrast to the method of exploitation followed by abandonment of former days. The aim, in brief, is the highly commendable one that all sections of a farm shall be so worked in respect of fertilizing, pruning, spacing, etc., as to make for a good general standard of productiveness.

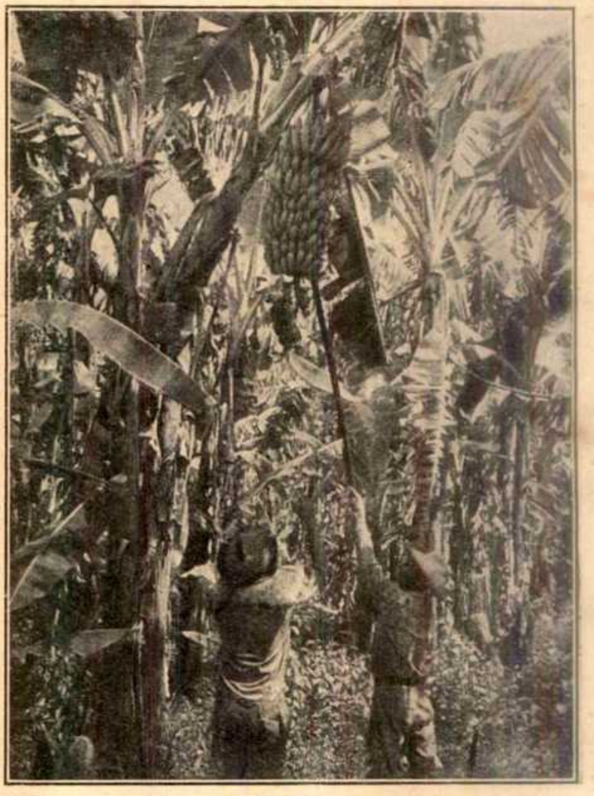

Fig. 3.

HARVESTING OF FRUIT, HONDURAS.

Reference has been made to the losses periodically caused by floods. These inundations are violent but usually of brief duration. They may prove exceedingly destructive, taking a heavy toll not only of plants and fruit, and leaving plantations a wilderness of smashed vegetation smeared with several inches of mud, but also permanent railroads and bridges may be swept away. The path of the flood water is determined by topography, fertile areas in the river bends being especially subject to inundation and erosion. A recent experiment of very considerable interest and practical value lies in the utilization of the silt-laden flood water, which is contained and controlled by channels and levees in such a way that its burthen of earthy matter is deposited in selected low-lying areas. Each flood—and several may occur in one year—thus results in the deposition, in swampy areas, of several inches of friable and fertile top soil, eroded from higher up the valley. In a surprisingly short space of time—a few years at most—hitherto valueless low-lying areas are so built up that they can be drained and planted with bananas. This useful work is now being undertaken on a not inconsiderable scale.

In the banana lands of the Ullua River (Republic of Honduras) such reclaimed areas can be seen to-day. They are supporting excellent stands of young plants, and the incidence of Panama disease was, as observed by me at the beginning of 1940, negligible. Such innovations are of the greatest significance in the agricultural development of Central America. They mark the transition from the impermanence and rough-and-ready exploitation of other days to the rational utilization of natural resources and to that permanence which should result from a system which aims at the maintenance of a high standard of productivity in favourable localities. To the consumer on distant markets, such preparations for the future also bring the assurance that there will be no abatement in the supplies or quality of the product to which he has become accustomed.

Some fifteen to twenty years ago, with the abandonment of vast areas on account of Panama disease and deterioration of fertility under continuous single crop cultivation, the question was frequently mooted as to the fate of the banana industry when all the good virgin areas became used up. The question is still asked and it may now be answered. So far as Central America is concerned, there seems no reason for supposing that production will seriously decline for many years to come. In recent years, there has not only been adequate production on the major properties, but actually over-production of bunches of the first quality. Extensive areas, mapped for banana growing, have not yet been touched, other new and highly productive areas are being developed on a very conservative scale, and, as indicated above, existing plantations are not only being maintained in first-class condition but also are being daily added to by the control of flood water.

To the agriculturist as to the layman, the spectacle of a modern banana division, comprising some sixty square miles under cultivation, with surface and overhead irrigation provided where necessary, and supplied throughout with a pipeline system for the application of Bordeaux Mixture (used to control Cercospora leaf disease), is one that engenders confidence for the future. To those who have been responsible for such notable achievements, and for much courageous experimentation on a grand scale, great credit is due.

THE BIRTH OF GLACIAL GEOLOGY*

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THE year 1840 will always be remembered as one of outstanding importance in the annals of geology. So far as Great Britain is concerned, glacial geology was born in 1840 with the visit to this country of Louis Agassiz. Glasgow will always be associated with this event, for Agassiz attended the tenth meeting of the British Association which was held there in the summer of 1840. At the meeting he took the opportunity of proposing the revolutionary theory "that at a certain epoch all the north of Europe, and also the north of Asia and America, were covered with a mass of ice". Woodward, in his "History of Geology" (1911, p. 121) has said: "Since the days of William Smith no more momentous, and, as time has proved, no sounder, explanation of a vast and difficult problem had been given in geological science."

Agassiz wrote: "In the early part of the summer of 1840, I started from Switzerland for England with the express object of finding traces of glaciers in Britain. This glacier-hunt was at that time a somewhat perilous undertaking for the reputation of a young naturalist like myself, since some of the greatest names in science were arrayed against the novel glacial theory. . . ."[1]

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* Part of an address to the Geological Society of Glasgow on December 14.

Towards the end of this essay Agassiz continues : "Of course the ancient glaciers of Great Britain were far more difficult to trace than those of Switzerland, where the present glaciers are guides to the old ones. Nevertheless, my expectations were more than answered. The first valley I entered in the glacial regions of Scotland was barred by a terminal moraine . . . the surface of the country [was] polished, grooved, and scratched, as in the region of existing glaciers, presenting an appearance corresponding exactly to that described elsewhere . . .". The satisfaction which Agassiz experienced on this occasion was probably equalled only on the excursion which he made from the steamer on first setting foot on the American continent in 1846.

Before considering the events of 1840 further, let me give a very brief account of the state of knowledge regarding superficial deposits and surface phenomena in general before that time. It is not my purpose to enter into details concerning the history of glacial research. Such a summary will help us to appreciate the far-sighted nature of Agassiz' conclusions.

As Agassiz himself said, it was at that time much easier to believe in the former extension of ice in the Alps than in the glaciation of the British Isles. We turn to the Alps, therefore, for information about glaciers, and we find that so far back as 1787 Kuhn believed in the former extension of the Grindelwald Glacier. Later, de Saussure, Hugi, Venetz, and Charpentier all emphasized the significance of valley moraines standing outside the limits of existing glaciers. In 1829, Venetz suggested the extension of the ice far beyond the mountain valleys to the great erratic blocks which lie on the slopes of the Jura Mountains. The existence of these enormous granite blocks had been pointed out by de Saussure, but the first actual suggestion that they were ice-carried came from James Hutton. Hutton never saw the boulders himself; he knew of them only through the writings of de Saussure. Before this it was generally believed that they had been transported by a great deluge, but according to Hutton's philosophy "general deluges form no part of the theory of the earth". Hutton's suggestion, however, was forgotten.

Hutton's famous disciples, James Hall and John Playfair, were more fortunate than their master, for they studied the granite blocks in the field. Hall followed de Saussure in attributing their transport to a gigantic wave. Playfair, confronted in particular with a block weighing some 2,520 tons at a distance of seventy miles from its source and with its corners conspicuously unrounded, came to the conclusion that "A glacier is the only agent we now see capable of transporting them to such a distance, without destroying that sharpness of the angles so distinctive of these masses"[2].

Venetz rediscovered the solution to the problem of the erratics and he was followed by Charpentier in 1834. Venetz and Charpentier may be considered the real founders of glacial research. Agassiz went further than both in his observations and from these he made deductions undreamed of by his masters.

It was under the personal guidance of Charpentier that Agassiz began his investigations of the Rhone erratics in the summer of 1836. This study, coupled with his knowledge of the literature, in a very short time led him to his great theory. In the winter of 1836–37 he lectured at Neuchâtel on the Ice Age and propounded the theory that the ice originally extended over the Alps as far as erratics, polishing, and striæ occur. Agassiz soon realized that the former extension of the Swiss glaciers must have resulted from some general lowering of temperature. In 1840 he published an account of glaciers in general, and in this he propounded the glacial theory. At that time he knew northern Europe only from the writings of others, and he was familiar with the striæ, moulding, and erratics of the Edinburgh district through the published descriptions of James Hall. It only remained for him to test his theory in the British Isles.

There is no doubt that up to the time of Agassiz' visit the superficial phenomena of Great Britain were looked upon as the work of a great deluge usually identified with the Biblical flood. The nearest approach to glaciers was the suggestion of iceberg-carry proposed by some writers.

Dr. Buckland of Oxford, one of the most influential writers of the 'golden age of geology', was the great champion of the geological proofs of the Biblical flood. At his inaugural lecture at the University of Oxford in 1819, Buckland announced that a universal flood is proved so decisively "that had we never heard of such an event from Scripture or any other authority, Geology of itself must have called in the assistance of some such catastrophe to explain the phenomena of diluvial action".

By 1837, however, Buckland was wavering in his support of the flood to the extent that he wrote that "This important point, however, cannot be considered as completely settled till more detailed investigations . . . shall have taken place." By this time Venetz, Charpentier, and Agassiz had made great strides with the interpretation of the surface features and deposits of the Alps. Glacial action in the ice-free valleys and mountain slopes were recognized by signs which Buckland realized were identical with the very phenomena he knew so well at home, and which he explained by a great deluge. He went to Switzerland in 1838 to visit Agassiz and see the evidence for himself. Of this visit Sollas has written, "a few days' personal investigation sufficed to convince Buckland of the truth of Agassiz' opinions". At the same time he must have been quite convinced in his own mind of the former glaciation of Britain, for he persuaded Agassiz to visit this country in 1840.

Let Agassiz tell the story in his own words: "Only one of my older scientific friends in England, a man who in earlier years had weathered a similar storm himself, shared my confidence in the investigations looked upon by others as so visionary, and offered to accompany me in my excursion to the North of England, Scotland, and Wales. I cannot recur to that delightful journey without a few words of grateful and affectionate tribute to the friend who sustained me by his sympathy and guided me by his knowledge and experience.

"For many years I had enjoyed the privilege of personal acquaintance with Dr. Buckland, and in 1834 when engaged in the investigation of fossil fishes, I had travelled with him through parts of England and Scotland, and had derived invaluable assistance from his friendly advice and direction. . . . A few years later he visited Switzerland, when I had the pleasure of showing him, in my turn, the glacial phenomena of my native country, to the study of which I was then devoting all my spare time. After a thorough survey of the facts I had collected, he became satisfied that my interpretation of them was likely to prove correct, and even then he recalled phenomena of his own country, which, under the new light thrown upon them by the glacial phenomena of Switzerland, gave a promise of success to my extraordinary venture. We then resolved to pursue the inquiry together on the occasion of my next visit to England; and after the meeting in Glasgow of the British Association for the Advancement of Science, we started for the mountains of Scotland in search of traces of the glaciers, which, if there was any truth in the generalizations to which my study of the Swiss glaciers had led me, must have come down from the Grampian range, and reached the level of the sea, as they do now in Greenland"[3].

The results of the Scottish tour were communicated to the Geological Society of London in November, 1840[4]. Sir Archibald Geikie has said that the views expressed by Agassiz and Buckland "were violently opposed and sarcastically ridiculed at the Society's Meetings when they were communicated"[5].

There is only an abstract of Agassiz' Glasgow address in the Report of the British Association. It seems to have covered much the same ground as was described in detail in the same year in "Études sur les Glaciers". At the Glasgow meeting he propounded the theory "that at a certain epoch all the north of Europe, and also the north of Asia and America were covered with a mass of ice. . . . "From his studies of the Alpine glaciers Agassiz was led to recognize the former existence of ice in Britain. Hutton's own doctrine that the present is the key to the past partly explains why he and Hall failed to recognize glacial phenomena in Scotland and why it was left to one familiar with modern glaciers to make the discovery.

We cannot close this account of 1840 without mention of James Smith of Jordanhill, who was president of the Glasgow Geological Society during 1851–67. Smith read a paper at the Glasgow meeting of the British Association in 1840 in which he pointed out the presence of shell-beds forty feet above sea-level and containing shells of arctic species now extinct around our shores. James Smith was the first observer to bring forward convincing evidence of the lowering of general temperature of our latitudes. He was the pioneer of glacial palæontology. Another of Smith's claims to fame is the share he had in launching A. C. Ramsay upon a scientific career. Ramsay exhibited his model, map, and sections of Arran at the Glasgow meeting of 1840, and it was as a result of this work that he joined the Geological Survey, of which later he became director general.

Bailey has aptly said that the glacial theory, launched in 1840, "registered an attack rather than a victory" and that for years to come it "seemed to have been repulsed". It was not until 1863 that land ice finally displaced icebergs and succeeded in claiming the greatest share in the glaciation of our country. In that year Sir Archibald Geikie published his famous paper "The Glacial Drift of Scotland"[6].

Although Geikie's paper of 1863 brought an end to the period of stagnation in glacial research that followed the announcement of the glacial theory, two important papers were published in the previous year: Ramsay's account of the glacial origin of rock-basins[7] and Jamieson's conversion from floating ice to land ice as a result of his tracing of ice-moulding uphill from Loch Fyne westward towards the Atlantic[8].

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[1] "Geological Sketches", Second Series (1876).

[2] "Illustrations", 349 (1802).

[3] "Geological Sketches", Second Series, 3–5 (1876).

[4] *Proc. Geol. Soc.*, **3**, 327–32, 332–7, 345–8; also Lyell, 337–45 (1840–41).

[5] Pres. Add. to the Geol. Soc., *Q. J. Geol. Soc.*, **64**, 92.

[6] *Trans. Geol. Soc. Glasgow*, **1**, Pt. 2, 1–190 (1863).

[7] *Q. J. Geol. Soc.*, **18**, 185–204 (1862).

[8] *Q. J. Geol. Soc.*, **18**, 164–84 (1862).

OBITUARIES

Dr. Cresswell Shearer, F.R.S.

Dr. Cresswell Shearer, who died at Cambridge on February 7, after a brief illness, will be remembered as one of the most interesting personalities in the ranks of British zoologists.

As a young man Shearer took a medical degree at McGill University, but his main scientific interests lay in the field of experimental embryology. He spent much time at Naples at a period when the Stazione Zoologica was perhaps at the zenith of its fame. There he met many of the great figures of late nineteenth century biology, and his recollections of this period were afterwards a constant source of delight and instruction to his own Cambridge pupils. In 1910 he settled in Cambridge, and shortly afterwards was appointed the first of a series of University lecturers in experimental zoology. The next decade was a period of active and productive research. They were also, however, years of unusual inspiration to students. His lectures were almost invariably unorthodox in presentation, if not in substance, but they gave a real insight into contemporary biological thought and threw into relief the lines along which future progress seemed likely to come.

Prior to the War of 1914–18, Shearer had published a number of important papers on the development of trochosphere larvæ and on sex determination in Dinophilus. In 1913 the *Philosophical Transactions of the Royal Society* contained the well-known monograph on "The Experimental Hybridisation of Echinoids", which was the result of Shearer's work in collaboration with W. de Morgan and H. Munro Fox. This work was carried out at Plymouth, where many of his pupils followed him in the summer months of each year. During the War, he returned to medicine and worked in the west of England. Here began many years of happy married life.

Shearer was elected a fellow of the Royal Society in 1916, and in 1918 returned to Cambridge to carry out a series of important researches on the effect of fertilization on the metabolism of the eggs of sea urchins. He showed, for the first time, that spectacular changes in oxygen consumption occur for a few seconds after the spermatozoon has entered the egg.

Shearer's versatility was perhaps one of the most characteristic features of his University career. He worked first in the Department of Zoology, then in those of Pathology, Physiology, and finally Anatomy, keeping in close contact with the younger research workers in all these and other laboratories. For several years he held the post of University lecturer in embryology in the Department of Anatomy. On his retirement from University work, he returned once more to the Zoological Department, much to the pleasure and advantage of the Department.

Apart from his biological interests, Shearer was a man of wide general learning. His knowledge of medieval Italian architecture was profound, and in 1935 he published "The Renaissance of Architecture in Southern Italy". It is to be hoped that his later work will also be made available to those interested in this field of learning. His ability as an artist and his enthusiasm for photography were not only of great value to him in both his scientific and literary work, but also gave very considerable pleasure to his friends.

Shearer was a man of rather retiring disposition, but once the thin crust of his reserve was broken, he revealed a warm-hearted and most generous nature. His memory will not readily fade. J. Gray.

Dr. J. G. Priestley

By the death of John Gillies Priestley, which occurred on February 9 at the age of sixty-one, the School of Physiology at Oxford has suffered a loss which it can ill afford, especially at this critical time when university education is faced by endless difficulties arising from the War. He was, it is true, somewhat reticent by nature, but those who knew him best gained in his friendship something that they prized. A man of great personal charm, generous to those in need, he was always ready to interrupt his own work to give help and advice to any who sought it. With a balanced judgment on the work of others, he was hypercritical of himself and modestly diffident of his own powers. Meticulously accurate in his experimental methods, no trouble was too great for him to take in his research work, and in his teaching he always tried to inculcate into his pupils some of his own gift for accurate observation and attention to detail. With a quiet courage and determination that was characteristic he fought against ill-health that told more and more upon him as the years passed, publishing his final paper in December 1940, and resigning his readership only a few weeks before his death when he knew that he had no longer strength to fulfil the duties of his office.

Priestley was educated at Eton and gained an open scholarship at Christ Church in 1898. It was whilst reading physiology at Oxford that he became acquainted with John Haldane, whose friendship was to have a great influence on his future career. As soon as he had taken his degree in 1902, he joined Haldane in an investigation which resulted, in 1905, in the publication under their joint authorship of that remarkable paper on the "Regulation of the Lung Ventilation" which was to play so large a part in the development of physiological knowledge. Leaving Oxford he then went to St. Bartholomew's Hospital to complete his clinical studies. After gaining his medical qualification he became house physician to Sir Wilmot Herringham, whose high opinion he won. After working for a year with Falta in Vienna he returned to St. Bartholomew's to take charge of the new Laboratory of Chemical Pathology which had just been opened, but within two years he developed tuberculosis of the lungs and had to go to Davos for treatment. The disease was checked, but pulmonary fibrosis left him with a legacy of ill-health, which was all the more tragic to a man who had a great interest in out-door sport and big game shooting, and had been a distinguished oarsman at Oxford.

Returning to Oxford in 1913 he began a series of investigations into the part played by the kidneys in the regulation of the composition of the blood, but this work was soon interrupted by the outbreak of the War of 1914–18. He volunteered at once, and was given a commission in the R.A.M.C. on September 1, 1914. Serving in France and Belgium he was in the following year awarded the Military Cross and was mentioned in despatches. He was wounded at Neuve Chapelle. Later in the War he was associated with Haldane and Meakins in an investigation into the after-effects of war-gas poisoning. When peace came he was appointed reader in clinical physiology at Oxford. His further investigations included work on various aspects of the physiology of respiration, on the function of the kidney, on some problems of general metabolism, and, more recently, he was engaged on a critical examination of methods for ascertaining the output of the human heart. He was again, and most appropriately, associated with Haldane as joint author of a new edition (1935) of Haldane's book "Respiration". With a clear appreciation of the relationship of physiology to medicine he was largely responsible for initiating a practical course of human physiology in the Final Honour School of Physiology, which led to the publication of "Human Physiology; a Practical Course", now in its second edition, of which he was joint author. For the Physiological Society he prepared a subject index of the first sixty volumes of the *Journal of Physiology*, and he succeeded John Mellanby in the editorship for a few years of *Physiological Abstracts*, a task in which his expert knowledge of the international decimal system for the classification of scientific papers proved of great service.

He leaves a widow, and a son, Major Charles Priestley.

C. G. Douglas.

Dr. Alexander Bowman

Among the men of science who have guided fishery research in Scotland, and they form a distinguished company, Dr. Bowman was marked by a grasp of the practical problems of the fisheries and of the scientific efforts which must lie behind the solution of these problems.

Yet scientific work was not his earliest notion of a career. He began by helping his father in a prosperous business in Aberdeen, and then proceeded to take the normal training for a teacher at the Free Church Training College in that city. It was after these first essays that he decided to enter the University, and to study for a degree in science. He graduated in the University of Aberdeen with distinction in zoology, and was awarded the Fullerton research scholarship in natural science, but before the completion of its tenure he resigned on being appointed naturalist to the Fishery Board for Scotland.

There he worked in collaboration with Sir D'Arcy Thompson, scientific member of the Fishery Board, and his early activities were centred upon the research steamer *Goldseeker* and the amassing of enormous collections made during the periodic voyages of that vessel, which were to help in explaining the movements of waters, the changes of salinity, the distribution of food materials, and thus to interpret the movements of the fishes themselves. Later he applied himself with great success to the solution of practical fishery problems, such as the elucidation of the enormous fluctuations in fish supplies, the forecasting of future yield, the effect of the size of mesh in influencing escapes of undersized fish, and so on. During these years he worked almost single-handed and with great devotion, spending month after month at sea in the stormy northern waters, laying the foundation of his vast knowledge of the fisheries in their scientific and practical aspects. In 1908, Dr. Bowman obtained the degree of D.Sc. at the University of Aberdeen for a thesis containing some of his pioneer work in the experimental study of fishing methods, notably on the otter trawl and its effect on the stocks of fish. His experience of fishery research was widened by periods of study in Denmark and Germany.

On the sudden death of Mr. Nelson, who had just succeeded Dr. T. Weymss Fulton as scientific superintendent of the Fishery Board for Scotland, Dr. Bowman was appointed to fill the post in 1923. In this position he developed his earlier researches and enlarged the scientific staff of the Board. An excellent example of the value of his methods is to be seen in his work upon the haddock, which has formed the foundation of the most thorough-going knowledge of one of our most important food fishes. He considered that one of his greatest honours was his appointment in 1925 as chairman of the Northern North Sea Committee of the International Council for the Exploration of the Sea, but the choice was not surprising, for his colleagues at home and abroad had the greatest respect for his knowledge and judgment, and he was properly regarded as one of the best fishery experts of his time.

Dr. Bowman's training as a teacher was made use of by the University of Aberdeen when it appointed him lecturer in the scientific study of fisheries, and in Aberdeen and the surrounding district he conducted classes in marine zoology for teachers and delivered popular lectures on natural history. In 1933 ill-health compelled him to resign from his post, and a lingering illness ended his life on January 14, when he was in his sixty-fifth year.

We regret to announce the following deaths:

Prof. F. A. P. Aveling, University professor of psychology in King's College, London, on March 6, aged sixty-five.

Miss Ethelind Gardiner, for thirty-five years secretary of the Royal Society for the Protection of Birds, on March 1.

Sir George Grierson, O.M., K.C.I.E., the Oriental scholar and compiler of the "Linguistic Survey of India", on March 7, aged ninety.

NEWS AND VIEWS

Nature and the War

Under the title "An American Message", we publish on p. 329 of this issue a complimentary note from the managing editor, associate editor and staff of the *Bell Laboratories Record*, the monthly journal of the Bell Telephone Laboratories, Inc. These Laboratories, which form one of the largest industrial research centres in the world, are well known to physicists and engineers for their research on electronic physics, chemistry, magnetism, optics, radio, applied mathematics, speech and hearing, and generation and modulation of electrical currents. Such a communication is very encouraging, and no doubt British readers will receive it with pleasure. This American message is merely a reflexion of the main body of opinion in the United States, finally endorsed by the signing of the Lease and Lend Bill by President Roosevelt on March 11, after it had been approved by the House of Representatives by the overwhelming majority of 317 to 71.

The letter is one of a large number already received, though this is the first from a group of men of science —the others having been sent by individuals. Nature is still carrying on despite the many and varying difficulties caused by the War and the air attacks on London. The subject material has, perforce, been modified, especially in the case of the physical sciences, since certain material must obviously be withheld for defence reasons. Furthermore, little material can be expected from countries outside the British Commonwealth and the Americas. This has caused a reduction in the correspondence columns, and the international character of Nature is thus temporarily impaired. This is regrettable, though it is difficult to conceive of any other situation, since even if communications abroad were still open between Great Britain and those countries at present closed to postal communication the editors of Nature would still pursue vigorously their policy of gathering the forces of science to help in the fight against aggression and against those at present repudiating and even suppressing truth and encouraging the propagation of falsehood.

Though situated in an area which has certainly had a share in the wanton destruction resulting from indiscriminate bombing, we are glad to say that, so far, the offices of Nature have suffered nothing but a few broken windows and occasional interruption of of work caused by the proximity of delayed-action bombs. In any event, arrangements have been in existence for some considerable time for Nature to carry on elsewhere in the unhappy event of its present home becoming uninhabitable for any length of time.

War and Scientific Research

In an article in the *Quarterly Review* of January on the effect of the War on scientific research, Mr. J. M. Watson emphasizes the extent to which fundamental, long-range research is interrupted by the necessity of concentrating effort on the solution of urgent day-to-day problems and investigations related directly to the war effort. The whole course of hostilities is profoundly affected by pure research, pursued in peace-time for no ulterior motive; meteorology and wireless telegraphy provide outstanding examples. But in spite of the great volume of special research instituted for the prosecution of the War, the general effect upon scientific advance is one of stultification. Moreover, it is the application of known principles rather than the discovery of new ones which provides the solution of urgent problems, and the reduction or cessation of pure research in war-time not only retards the progress of science but also interrupts its stimulating and fertilizing effect on all scientific work, including *ad hoc* research. Mr. Watson also refers to the lack of co-ordination between scientific advisers and executive authorities which hampers progress, as well as to the danger which attends the absence of a scientific outlook in circles wielding political and executive power. Moreover, the scientific outlook and the results of scientific research must play an even bigger part in post-war reconstruction than in the War itself.

The problems which confront the research worker in war-time are placed by Mr. Watson in six main groups. The first of these includes the medical and surgical problems, whether of epidemic disease, the treatment of wounds, the treatment or prevention of secondary infections of wounds, or the investigation of means of promoting speedier healing. The second group embraces problems relating to the supply of raw materials, on which so much German effort has been concentrated. The War has given a tremendous stimulus to industrial research in the use of synthetic plastics. The third group includes problems relating to the production or improvement of weapons of war, including the various precision instruments and such problems as those of camouflage, where Mr. Watson stresses the importance of the psychological factor. In the fourth group of problems, relating mainly to the civilian population, which have been comparatively neglected until very recently, the difficulties are concerned with social research and education and with effective control of vested interests, rather than with scientific research. This group includes such matters as agricultural research, nutrition, the nervous disorders arising from aerial bombardment and like aspects of public health. Problems summarized under the heading of public relations, notably propaganda and morale, and the scientific investigation of matters bearing on industrial efficiency, such as hours of work, ventilation, lighting, noise, etc., comprise the fifth group, while in the sixth group are to be placed the entirely new set of investigations arising from the introduction of air raid precautions.

The National Day of Prayer

HIS MAJESTY THE KING, having expressed a desire that March 23 should be observed as a national day of prayer, statements have been issued by leaders of religious bodies in Great Britain. Dr. Lang, the Archbishop of Canterbury, after observing that "we are now approaching or entering a critical stage in the tremendous struggle", considers it most fitting that the King, as head of the nation, "should once again call it to renew the acknowledgement of its need of God and dependence on Him", and to pray for "His forgiveness of all that has been amiss in our national life, for strength and guidance in the stern and testing days which may be coming, and, if it be His will, for good success". The Primate observes also that with such prayers it is right that "we should offer thanksgivings for mercies already received", alluding to "the wonderful way in which we have escaped the dangers which surrounded us last summer and autumn". His Eminence Cardinal Hinsley, Archbishop of Westminster, declares that, "the stern trials that face us call for the light and strength which God alone can give. Moreover, the mercies we have received in answer to prayer should cause us to lift up our hearts in thanksgiving to 'the God of all consolation' ". His Eminence also urges the faithful "to pray that this deadly strife among nations may speedily end in a true peace based on justice and love".

The statement issued by the Rev. Sidney M. Berry and the Rev. S. W. Hughes, on behalf of the Free Church Federal Council, appeals to Free Churchmen throughout the country to observe the Day of Prayer. "The struggle in which we are now engaged they declare, "will never issue in the kind of world we want to see by relying merely on the power of material weapons and resources. Our supreme need is for God's guidance and strength". They urge that the day of prayer be freed "from any false ideas that prayer is a kind of magic, or that we only turn to God when we are at our wit's end". To be truly observed the day must mean "a dedication of ourselves through days of peril into those other and happier days of victory and peace, when dangers of another kind may come to us". The Chief Rabbi, Dr. J. H. Hertz, in his statement declares that "his Majesty's Jewish subjects will loyally obey the royal summons", using "supplications to our Father in Heaven for strength and guidance, as well as prayers of thanksgiving for the mercies and victories hitherto granted to the forces of freedom".

Railways under War Conditions

THE vigorous defence of the operation of the railways under war conditions, which Lord Stamp offered in his chairman's address at the annual general meeting on March 7 of the London, Midland and Scottish Railway Company, contained an interesting reference to the work of the Company's Research Department, the very great value of which in solving war-time problems he emphasized. Such problems as substitute materials, salvage, air raid precautions and black-out could only be solved quickly and effectively by scientific methods. Lord Stamp referred particularly to the work of the Research Department on treatment of the windows of signal boxes without interfering with clear vision, which had proved so effective that in the boxes so treated not a single man had been injured by glass splinters ; the importance of this in maintaining confidence and operating efficiency can be imagined. With the lighting section, the Research Department has also contributed to the development of scientific methods, enabling a combination of safety from observation with the best permissible lighting to be used in dealing with the innumerable problems of lighting the black-out in goods sheds, marshalling yards and elsewhere. Lord Stamp's spirited reply to criticism, which has sometimes been somewhat irresponsible and carping, made it clear that the handicaps on the railways and the strain on their reserves could be mitigated by intelligent forethought on the part of the Service Departments. It may be hoped that his indictment of want of foresight or worse will not escape the notice of that invaluable watch-dog over administrative weaknesses—the Select Committee on National Expenditure.

British Medical Students in the United States

THE Minister of Health, replying in the House of Commons to a question by Prof. A. V. Hill, said that he was aware that an offer had been received from the Rockefeller Foundation in New York to undertake and provide for the clinical training and maintenance of selected British medical students in medical schools in the United States of America and in Canada. A committee to select students has been set up in Great Britain under the chairmanship of the Vice-Chancellor of the University of Manchester, Prof. J. S. B. Stopford, and consisting of Prof. H. R. Dean (vice-chairman), Prof. H. W. B. Cairns, Mr. H. L. Eason, Prof. G. E. Gask, Mr. G. F. Gibberd, Dr. A. M. H. Gray, Prof. A. V. Hill, Surgeon Rear Admiral J. W. McNee, Sir Walter Moberly, Sir Franklin Sibly and Mr. W. B. Brander, of the Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (secretary). The first group of students will leave for America as soon as possible.

The Rockefeller Foundation's grant is of 100,000 dollars, and will suffice for about twenty-five studentships, providing cost of tuition and maintenance for two or three years. It comes at an opportune moment, when clinical studies in Great Britain are of necessity being continued under difficulties imposed by shortage of teaching staff, many of whom are on active service, and by damage caused to some of the leading hospitals by enemy action. The selected students will go to various universities in the United States and Canada, where they will be able not only to complete their medical studies, but also to obtain valuable experience of practice and research in North America. This generous grant is yet one more demonstration of the desire to help and practical interest of the United States in the preservation of European standards of life.

Economy in Drugs

A MEMORANDUM on "Economy in the Use of Drugs in War Time" by the Therapeutic Requirements Committee of the Medical Research Council has been issued as an official publication. It is based on the provisional lists circulated last autumn, a summary of which appeared in NATURE (October 12, 1940). These lists have been thoroughly revised and greatly extended. Some five hundred drugs are classified into three groups: (1) essential or readily available; (2) essential for certain purposes but in the use of which strict economy should be observed; and (3) not essential. By a recent Defence Regulation, the Ministry of Health was empowered to make Orders authorizing the replacement of scarce drugs by alternatives having substantially the same therapeutic action; it is understood that the Medical Research Council is the body which advises on essential and non-essential medicinal substances, and consequently this memorandum is of no little importance, since it may be taken that it gives at least some indication of the drugs which may be the subject of Orders. In the meantime, medical men are expected to avoid the prescription of drugs in classes 2 and 3 so far as possible. Of more permanent interest is an appendix to the memorandum, consisting of the names of drugs which, in the view of the Medical Research Council, should be produced in the British Empire and should be encouraged.

Post-War Building and Planning

SOME aspects of the problem of post-War building are discussed in *Electrical Industries* of February. It seems clear that some limitation of the size of our future towns and cities will have to be seriously contemplated. This, in turn, will inevitably give rise to many indirect problems of a complicated nature. From the point of view of electrical supply, no matter what type of building in our reconstructed areas is finally decided on, the vast potentialities for the extended use of electricity can readily be visualized; especially when we bear in mind that the work of reconstruction will not only be confined to housing, but will also embrace industry and its location. The general plan of reconstruction will probably take into consideration, besides the bombed areas, those slum clearance schemes held in abeyance for the duration of the War. It would be dangerous to encourage the public to expect too much from post-War reconstruction, especially in its early stages, and already a warning has been issued by Lord Reith on this subject. So far as electric supply authorities are concerned, many of the pre-War development schemes which have necessitated, or will necessitate, the laying down of new sub-stations and networks to cater for future requirements may have to be drastically revised. One of the most important points is that when normal times return and the preliminary surveys are made, the electric supply industries, assisted by such bodies as the Electrical Development Association, the British Standards Institution and the British Electrical and Allied Industries Research Association, should be in a position to place immediately before the appropriate authority the electrical position in its entirety.

Air Raid Damage to the London Museum

THE damage sustained by the London Museum has been confined almost entirely to its glass. The major portion of the windows on the south front, the glass in the lantern of the Main Hall and that of the lantern in the Costume Gallery, which was of ground-glass, decorated with allegorical figures, have been destroyed. The matchless gilded ceilings and the painted panels have, however, escaped damage, and even the original chandeliers and candelabra have been in the main uninjured. Before the outbreak of war, most of the collections were removed from the building, only some of the more cumbrous exhibits and models being left in the basement, and a small collection of less important duplicate material being retained for special exhibitions, and for the illustrations of a course of lectures, which was given in the early part of last year. The collections are thus intact, even the material remaining in the building being unharmed.

Alcohol and Vitamin A

IN a recent issue of *Science* it is claimed by Drs. Samuel W. Clausen, Burtis B. Breeze, William S. Baum, Augusta B. McCoord and John O. Rydeen, of the University of Rochester School of Medicine and Dentistry, that taking alcohol raises the vitamin A content of the blood in men as well as dogs. 'Before-and-after' tests were made on ten persons taking alcohol in the form of mixed drinks as desired. In every case the amount of vitamin A in the blood was increased after the drinking. The increase was relatively slight in most cases but was remarkably large in one person who had a high level of vitamin A in his blood before the drinking. Night-blindness is one of the chief signs of lack of this vitamin, although it is required for health of other parts of the body besides the eyes, and for normal growth of children.

Tests of ability to see in the dark, one method of determining whether a person is getting enough vitamin A, made after drinking, showed unaccountably short recovery time in dark adaptation. Dr. L. B. Pett, of the University of Alberta, who made this observation, suggested that the reason was the mobilization of vitamin A from its storage place in the body, presumably the liver, to the blood, which would distribute it to other parts of the body including the eyes. The vitamin A tests reported by the Rochester scientific workers were made on the blood, not the eyes. They also believe that the increase in blood vitamin A after alcohol is due to a mobilization of the vitamin from other tissues. They suggest that this might form the basis of a test for vitamin A storage in the body.

Alcohol and Brain Metabolism

IN a recent paper (*Amer. J. Psychiat.*, 97, 385; 1940), Drs. Walter W. Goldfarb, Karl M. Bowman and Joseph Wortis of the Psychiatric Division, Bellevue Hospital, New York, report the effects of ethyl alcohol on the metabolism of the brain in ten patients admitted to hospital presenting the clinical picture of acute alcoholic intoxication. The estimation of cerebral metabolism was based on the difference between the concentrations of various substances in the arterial and venous blood of the brain. The arterial blood was taken from either the brachial or femoral arteries, and the venous blood from the internal jugular vein. During the condition of acute intoxication the cerebral uptake of oxygen was diminished in six cases and within normal limits in four, while after recovery the uptake of oxygen was within normal limits in all cases.

Whale Marking

AFTER a considerable amount of experimenting the Discovery expedition evolved a satisfactory device for marking whales, in the form of a stainless steel tube 10 in. long that can be fired from a 12-bore gun. In the four seasons 1934–38 a total of 5,219 whales of six species was considered to be satisfactorily marked. G. W. Raynor (Discovery Reports, 19; 1940) describes the methods of marking, the data provided by the marks so far returned and discusses their significance. Of the three main species to be marked, the Blue, the Fin and the Humpback, there have been 187 returns out of 1,513 marked. This is not a large number, and it will obviously be increased in the course of time; but in view of the present conditions it was considered advisable to publish the results so far obtained. The Blue stock is being depleted faster than the Fin stock; but the Humpbacks are suffering most heavily. Blue whales round South Georgia are not a stationary group but move west towards the end of the whaling season. Similarly, Fin whales, although they may remain longer, move off to the south. The Humpbacks probably have an annual migration from the Antarctic to the north-west coast of Australia and to Madagascar. They also tend to remain more together and so do not exhibit the dispersal shown by the other two stocks. The dispersal is not quite so marked in the Fins, so that there appear to be "provinces" within which there is considerable movement but between which there is very little exchange of stocks.

The Heating of Buildings

AT a meeting of the Newcomen Society, held at the Institution of Civil Engineers on February 12, Mr. A. F. Dufton read a paper entitled "Early Application of Engineering to the Warming of Buildings" in which he reviewed the improvements of fire-places and stoves, and the introduction of heating by steam and hot water. The old open fire-place has long been recognized as a most wasteful and inefficient means of heating a room, and it was to economize fuel that Franklin in 1745 introduced the Pennsylvanian fire-place by which he reckoned to save five-sixths of the fuel. Many years before Franklin, a French physician, Nicholas Gauger, had published a work, "La Mécanique du Feu", and had described the ventilating fire-place. In his work he referred to a form of such fire-place which had been installed in the library of the Louvre. Steam heating was used by Watt as early as 1784, but his tin-plate radiation was not satisfactory. Sir John Leslie's experiments in radiant heat had not then been made. Among the pioneers of heating Rumford was one of the most successful, and in his writings pointed out the necessity for double-windows to rooms. Strutt of Derby was another pioneer of this time. Heating by hot water was used in France in 1777 by M. Bonnemain for his chicken incubators, and to Perkins we owe the use of the high-pressure hot-water system. Another improver of stoves was Dr. Neil Arnott, who in 1854 was awarded the Rumford Medal of the Royal Society.

Lubrication Technique

EXPERIMENTS for determining both the qualities and methods of application of lubricants are sometimes vitiated by being carried out too quickly. An oil behaves quite differently, for example, when introduced in a properly run-in bearing and when used in one that has been recently assembled. A very similar case occurs with oil containing colloidal graphite. This oil when used in a short-duration test may give results which are misleading. It is claimed by the manufacturers of a product of this nature, Messrs. E. G. Acheson, Ltd., Thames House, Millbank, London, S.W.1, that the particles of graphite in colloidal suspension form a slippery surface on the working faces of the parts in contact, but that, due to the stable nature of the lubricant, an appreciable time may be required for the particles to become adsorbed on the surfaces. Research has shown that the rate of adsorption on a metallic base depends, to a great extent, on the viscosity and chemical nature of the carrier, this rate being low for oil of average viscosity and high for water, which has a relatively low viscosity.

Confirmation of this finding may be found in a paper by Messrs. Fogg and Hunwicks, entitled "The Static Friction of Lubricated Surfaces", published in the *Journal of the Institution of Petroleum Technologists* of January. To facilitate comparative tests, Messrs. Acheson have now developed a technique to which they have given the name 'pre-lubrication'. This consists simply of forming a graphite coating or film on the working surfaces prior to assembly, by spraying or brushing colloidal graphite on to them, the graphite being applied, in this case, in a volatile carrier such as carbon tetrachloride, white spirit or acetone. The rapid evaporation of the carrier leaves a lubricating graphited surface, thicker, naturally, than one deposited during normal lubrication, but functioning in much the same way. The formation of the initial film does not eliminate the necessity for using colloidal graphite in the lubricating oil during the normal running-in period, and afterwards if desired, since the graphited surface requires renewal from time to time.

Mammals and Man

REFERENCE was made in NATURE of Feb. 22, to the temporary exhibition "Mammals and Man" at the National Museum of Wales, and to the lack of references in the guide-book "to modern developments such as the varied and most important uses of whale oil, the increasing resort to mammal products in biological therapy", etc. Mr. Colin Matheson, curator of the Museum, informs us that a well-known British firm has provided samples of vitamin A concentrate prepared from whale liver, hydrogenated whale oils of various melting points, spermaceti, and other important cetacean products, for the exhibition. The exhibit was unfortunately delayed in transit owing to war conditions, and did not arrive until the guide-book was in the press.

William Withering

MARCH 17 marks the bicentenary of the birth of Dr. William Withering, who was celebrated alike as physician, botanist and mineralogist. He was born at Wellington, Shropshire, the only son of Edmund Withering, a surgeon. He received his medical education at Edinburgh, where he qualified in 1776 with a thesis on "Malignant Putrid Sore Throat", which he afterwards identified with a severe form of scarlet fever. After a visit to Paris, where he attended a meeting of the Royal Academy of Sciences, he settled in Stafford in 1767 and first began to collect flowers. In 1775 he moved to Birmingham, where he soon acquired a lucrative practice, and the following year published his most important work entitled "A Botanical Arrangement of all the Vegetables naturally growing in Great Britain". The book went through seven editions, and an abbreviated version, of which three were published, by W. Macgillivray, first appeared in 1830.

At Birmingham Withering became a member of the Lunar Society, so called from its monthly meetings, and made there the acquaintance of Priestley, Watt and other distinguished men of science. In 1779 he published his "Account of the Scarlet Fever and Sore Throat, particularly as it appeared in 1778–1779", which is an important contribution to epidemiology and clinical medicine. In 1785, when he was elected F.R.S., appeared his classical paper on the foxglove, the value of which in dropsy he had learnt from an old woman in Shropshire, an excellent example of a folk-lore remedy being adopted by the orthodox profession. His interest in mineralogy is shown by the several contributions to the *Transactions of the Royal Society*. He also translated and annotated a treatise entitled "Outlines of Mineralogy" by Bergman "(1783). During a visit to Lisbon in 1795 he wrote a paper on "A Chymical Analysis of the Water at Caldas da Rainha, in Portugal", which he presented to the Royal Academy at Lisbon, for which he was admitted a foreign corresponding member.

His name has been given to the mineral known as 'witherite', consisting of barium carbonate, which he recognized to be distinct from baryta, as well as to the genus of Solanacea (*Witheringia Solanacea*). In 1792 he contributed a paper entitled "A Method of preserving Fungi, ascertained by Chymical Experiments" to the *Transactions of the Linnean Society*, of which he was elected a fellow the following year. He died on October 6, 1799, and was buried at Edgbaston, where the church contains his monument with a represensation of a foxglove on the right and of *Witheringia Solanacea* on the left.

Announcements

THE following promotions and transfers have recently been made in the Colonial Service: J. D. Broatch (agricultural superintendent), senior agricultural superintendent, Gold Coast; D. H. Brown (agricultural officer), senior agricultural officer, Nigeria; T. A. Buckley (chemist), senior chemist, Malaya; K. T. Hartley (chemist), senior chemist, Nigeria; L. J. Packham (agricultural superintendent), senior agricultural superintendent, Gold Coast; L. S. Davis (assistant Government analyst), Government chemist, Trinidad; E. J. Strugnell (senior assistant conservator), conservator of forests, Malaya; Dr. C. M. Tattam (geologist), senior geologist, Nigeria.

MESSRS. OLIVER AND BOYD LTD., Tweeddale Court, Edinburgh, and 98 Great Russell Street, London, W.C., have been appointed publishers to the Royal Society of Edinburgh. Copies of previous issues of the *Transactions* and *Proceedings* and of all future publications of the Society will now be supplied by this firm.

THE Canberra Experiment Station of the Plant Industry Division of the Australian Council for Scientific and Industrial Research is to be removed to a new area to the north of the capital, about four miles from the laboratories at Black Mountain. The area is eight hundred acres, of which six hundred are red and grey loams and the remainder rather lighter. The site is ideal for experimental work, and it should be possible in time to develop on it a first-class investigation centre.

ACCORDING to the seventeenth annual report of the Ella Sachs Plotz Foundation for the Advancement of Scientific Investigation, eighty-one applications for grants were received by the trustees, and twenty-three grants were made. In the seventeen years of its existence the Foundation has made three hundred and ninety-four grants, which have been distributed to investigators in most countries of the world. For the present, researches are being favoured that are directed towards the solution of problems in medicine and surgery or in branches of science bearing on medicine and surgery. Grants may be used for the purchase of apparatus and supplies that are needed for special investigations. The maximum grant will usually be less than 500 dollars. Applications for grants to be held during the year 1941–42 must be in the hands of the Executive Committee before April 1941. Applications should be sent to Dr. Joseph C. Aub, Collis P. Huntington Memorial Hospital, 695 Huntington Avenue, Boston, Massachusetts, U.S.A.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "Letters" will not be submitted to correspondents outside Great Britain.

Nicotinamide, Cozymase and Tissue Metabolism

The importance of cozymase as a fundamental constituent of certain respiratory processes in the living cell is now well established. It is known that cozymase is necessary for the activity in animal tissues of specific dehydrogenases oxidizing alcohol, lactate, malate, triosephosphate, etc. Its mode of action is reasonably clear. After combination with a dehydrogenase, it is reduced by a substrate (for example, lactate) with the formation of reduced cozymase and the oxidized product of the substrate (for example, pyruvate). The reduced cozymase is oxidized to its original form by other enzyme systems in the cell, transfer of hydrogen from the substrate to the final oxidizing agent being thus accomplished. Cozymase acts as a catalyst in the transfer of hydrogen in the cell, and in the intact tissue a dynamic equilibrium between reduced and oxidized cozymase is presumably always maintained.

Whilst carrying out investigations into the respiratory activity of tissues damaged by breaking up the cell structure we have found that such tissues (for example, brain, liver, kidney) possess an agent which breaks down cozymase at a rapid rate. The brain in particular is rich in this factor, as will be seen on examining the typical results shown in Table 1.

Table I

Lactic dehydrogenase system consists of a mixture of skeletal muscle lactic dehydrogenase, heart muscle flavoprotein, sodium lactate solution (0·13 *M*.), sodium cyanide (0·083 *M*.) and methylene blue (0·017 per cent) in phosphate buffer (0·02*M*.) *p*H 7·4. Brain preparation consists of a suspension of finely ground rat brain (1 gm. to 10 ml. saline).

	Oxygen uptake at 37° in 1 hour
Lactic dehydrogenase system	24·0 c.mm.
+ cozymase (1 mgm.)	205·2 „
+ cozymase + 0·2 ml. brain preparation	108·9 „
+ cozymase + 0·4 ml. brain preparation	64·0 „
+ cozymase + 0·1 per cent nicotinamide	195·9 „
+ cozymase previously incubated for 15 min. at 37° with 0·2 ml. brain preparation	54·1 „
+ cozymase previously incubated for 15 min. at 37° with 0·2 ml. brain preparation + 0·1 per cent. nicotinamide	167·2 „

These observations show that the addition of a small quantity of a suspension of finely ground brain tissue to a system containing lactic dehydrogenase, cozymase, flavoprotein and lactate greatly diminishes the rate of oxidation of the lactate. This diminution of activity is due to the breakdown of cozymase by the brain suspension. This is shown (see Table 1) by adding to the lactic dehydrogenase system a cozymase preparation which had been incubated for a short period with a small quantity of brain suspension. Such addition leads to little or no increased respiratory rate, in contrast to that which takes place when cozymase alone is added to the system. It may be shown, too, that the inhibiting action of a small quantity of brain suspension on cozymase activity applies not only to the lactic dehydrogenase of rabbit skeletal muscle (results of which are given in Table 1) but also to that of a rat kidney preparation (see Tables 2 and 3). A result given in Table 2 shows that the factor present in brain which inactivates cozymase is also present in liver, and we have evidence to show it is present in kidney, though in smaller amount. Further evidence has been secured which shows that the inactivation of cozymase by tissues may take place under strictly anaerobic conditions and we conclude, for the time being, that the inactivation is due to a hydrolysis of cozymase by a nucleotidase.

Table 2

Kidney system consists of a suspension of finely ground rat kidney tissue (1 gm. to 10 ml. saline), sodium cyanide (0·083*M*.) and methylene blue (0·04 per cent). Liver preparation consists of a suspension of finely ground rat liver (1 gm. to 10 ml. saline).

	Oxygen uptake at 37° in 1 hour
Kidney system + sodium lactate (0·13 *M*.)	59·9 c.mm.
+ cozymase (1 mgm.)	189·4 „
+ cozymase + 2 ml. brain suspension	58·5 „
+ cozymase previously incubated with 0·2 ml. liver preparation	57·8 „

Table 3

	Oxygen uptake at 37° in 30 min.
Kidney system + sodium lactate (0·13 *M*.)	
+ cozymase (1 mgm.)	66·0 c.mm.
+ cozymase + nicotinamide (0·1 per cent)	89·8 „
+ cozymase + 0·2 ml. brain suspension	10·5 „
+ cozymase + 0·2 ml. brain suspension + nicotinamide (0·1 per cent)	77·1 „

It is evident that, since brain tissue contains a most active cozymase nucleotidase, rapid synthesis of cozymase must take place in intact brain tissue examined under optimal respiratory conditions in order to balance the nucleotidase activity and to account for the maintenance of oxidative activity of brain when this is allowed to respire *in vitro* in a lactate medium. (Alternatively it must be concluded that cozymase nucleotidase is ineffective in intact animal tissues under aerobic conditions.) Hence there must exist in intact tissue an equilibrium between the mechanisms responsible for synthesis of cozymase and those responsible for its breakdown. The existence of this equilibrium probably accounts partially for the fact that the respiration of minced or ground tissues is often much lower than that of intact tissues; in the former tissues synthetic mechanisms are impaired, probably by loss of cell constituents by diffusion, etc.

We decided it would be of interest to discover how the cozymase nucleotidase activity of ground tissues could be inhibited. We have found that nicotinamide

—a constituent of cozymase—brings about such an inhibition. Results given in Table 1 show that if cozymase is incubated in presence of a small quantity of brain suspension together with 0·1 per cent nicotinamide, very little breakdown of the cozymase takes place. Results given in Table 3 show the stimulating action of nicotinamide on the oxygen consumption, when this is added to a kidney preparation of lactic dehydrogenase to which cozymase and brain suspension have also been added. The effect of nicotinamide on the activity of brain tissue itself, in the presence of lactate and cozymase, is shown in Table 4, where typical results obtained by the technique of Quastel and Wheatley[1] are given.

TABLE 4

Brain system consists of 1 ml. brain suspension (1·6 gm. chopped rat brain in 16 ml. Locke solution), cozymase and sodium cyanide (0·05 *M.*) in bicarbonate-Locke medium (*p*H 7·4). Sodium ferricyanide (0·2 ml. 10 per cent) was added, in an atmosphere of 95 per cent nitrogen + 5 per cent CO_2, and the evolution of CO_2 measured.

	CO_2 output at 37° in 1 hour
Brain system	85·6 c.mm.
+ nicotinamide (1·0 per cent)	85·6 ,,
+ sodium lactate (0·13 *M.*)	107·5 ,,
+ sodium lactate (0·13 *M.*) + nicotinamide (1·0 per cent)	357·8 ,,

These results make it clear that nicotinamide exerts an inhibitory effect on the breakdown of cozymase by a tissue nucleotidase. A few experiments have indicated considerable specificity of nicotinamide in this respect. Nicotinic acid at the concentrations we have used has no effect. It would not be expected that nicotinamide would effect any stimulation of the respiration of intact tissues obtained from healthy animals since in such tissues the breakdown of cozymase is balanced by its synthesis. Experiment shows that 0·1 per cent nicotinamide does not increase the respiration of intact brain slices in a lactate medium. There is, on the contrary, a small inhibition of the respiration such as has already been reported by Baker, Fazekas and Himwich[2].

This demonstration of the action of nicotinamide in protecting cozymase from breakdown, possibly by competition for the nucleotidase, raises the question as to whether the well-known therapeutic effects of nicotinamide may not be due partly to this action. If this view is true, substances other than nicotinamide having a similar protective effect may have similar therapeutic effects. It is interesting to note in this connexion that Vilter and Spies[3] have shown that quinolinic acid will cure pellagra and that Wooley *et al.*[4] find that a variety of nicotinic acid derivatives will cure canine black tongue. Moreover, as a result of the administration of quinolinic acid there has been found[3] an increase in concentration of cozymase in the blood.

Work on this problem is still in progress and further details will be published in due course.

We are grateful to the Rockefeller Foundation and to the Medical Research Council for financial help.

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Rates of Oxidation of Isomeric Dihydroxy- and Tetrahydroxy-stearic Acids by Lead Tetra-acetate

MEASUREMENTS of the rate of consumption of lead tetra-acetate, when used in strictly comparable conditions to oxidize various isomeric polyhydroxystearic acids, have revealed marked differences between the speed of oxidation of isomeric forms. We have observed these differences both in the two isomeric 9, 10-dihydroxystearic acids (m.p. 95° and 132°) and in the four known forms of 9, 10, 12, 13-tetrahydroxystearic acids (m.p. 173°, 163°, 146° and 134°). Further measurements are in progress in the group of tetrahydroxy-acids, and the complete results of this work will be reported in fuller detail later.

The data in the accompanying table show the rate of oxidation of the two 9,10-dihydroxystearic acids when each (0·0005 mole) was oxidized in glacial acetic acid (100 ml.) containing lead tetra-acetate (0·001875 mole) at 20°:

Time (min.)	Moles lead tetra-acetate consumed per mole dihydroxystearic acid	
	Acid m.p. 95°	Acid m.p. 132°
0·5	1·23	0·10
1·5	1·48	0·18
2·5	1·60	0·27
3·5	1·64	0·37
4·5	1·70	0·45
10	1·78	0·64
25	1·87	1·05
55	1·95	1·48
100	1·97	1·72
160	2·01	1·80

The rate of oxidation of the acid, m.p. 95°, is far more rapid than that of the isomeric form, m.p. 132°. The difference in the rate of oxidation of the two acids is similar to that of many pairs of cyclic glycols; Criegee[1] has shown, in the case of the latter geometrical isomerides, that *cis*-glycols are attacked by lead tetra-acetate more rapidly than the *trans*-isomerides. In the acyclic polyhydroxystearic acids, however, the stereoisomerism is that of two (racemic) asymmetric carbon atoms, and is not a case of geometrical isomerism.

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[1] Criegee, *Ber.*, 64, 260 (1931); 65, 1770 (1932). *Ann.*, 507, 159 (1933).

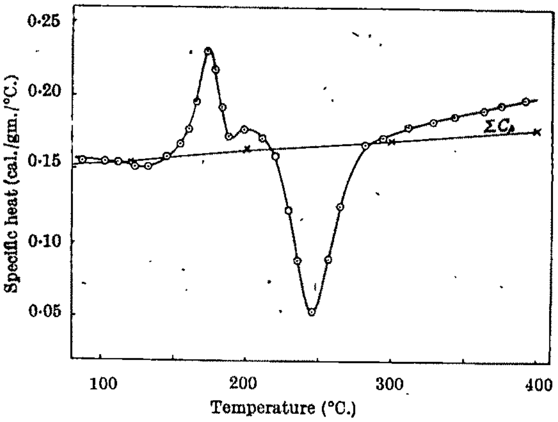
Pre-Precipitation Phenomena in Age-Hardening Alloys

USING an improved X-ray technique, Preston[1] and Guinier[2] have shown that when aluminium-copper single crystals containing 4 per cent copper are aged at low temperatures, thin plates of copper-rich atoms are formed on (100) planes of the crystal. Swindells and Sykes[3] found, from specific heat measurements on a similar alloy, that when specimens previously aged at low temperatures were re-heated, heat was absorbed before the chemical energy of precipitation was liberated. They suggested that this energy absorption was due to the dispersion of the copper-rich plates formed during the low-temperature ageing, an interpretation which was confirmed by Preston.

The fact that no change is observed in the lattice spacing of the crystal as a whole, even though nearly half the energy of precipitation may be released by the low-temperature ageing, suggests that the segregation of copper atoms is largely on the solid solution lattice, or in other words the precipitate has not broken away to form separate crystals, distinct from the matrix.

Aluminium-copper was the only alloy in which such pre-precipitation phenomena had been detected by X-ray methods, but recently Barrett and Geisler[4] have observed that plates of silver-rich atoms are formed on the (111) planes of a single crystal of an aluminium-silver alloy containing 20 per cent of silver, after ageing at low temperatures.

We have determined the specific heat - temperature curve of a specimen of an aluminium-silver alloy containing 40 per cent of silver quenched from 550° C. and aged for seven days at room temperature. The accompanying curve was obtained using the method described by Sykes and Jones[5]. The line marked ΣC_p shows the specific heat of the alloy calculated from the specific heats of pure aluminium and pure silver. The specific heat - temperature curve found experimentally bears a marked resemblance to those of Swindells and Sykes on aluminium-copper and may be interpreted similarly. The energy measurements thus give some confirmation for the X-ray results of Barrett and Geisler.



Although these workers have not investigated the point, it is to be expected that what Mehl[6] calls retrogression, such as is observed in aluminium-copper alloys, would also occur in aluminium-silver alloys.

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Weighing Living Marine Animals

THE substance of Dr. Gohar's letter[1] is contained in his fourth paragraph : "It is therefore possible to determine the volume and weight-in-air of such animals, excluding the water they contain, by weighing in two samples of water of different but known specific gravities". No experiments are described. The Archimedean formula is correctly stated on the assumption that the volume of the animal remains the same in the two samples of water : this can be true of few animals.

L. C. Beadle[2] experimented on the changes in sinking weight of the common polychaete worm *Nereis diversicolor* after transference from sea water to various dilutions. Nereis is a favourable subject since it is markedly euryhaline ; the specimens observed were gathered from an estuary where, with rising and falling tide, the worms changed twice a day from an environment of sea water to one diluted by river water, sometimes down to 60 per cent of its former salinity. Schlieper is quoted as having collected Nereis in water of salinity equivalent to only 12 per cent of sea water.

Beadle finds that after transference from 100 per cent to 25 per cent sea water "the weight rose to a maximum after 5–7 hours and then fell to a relatively steady value at 24–30 hours". The following extract showing separate observations on six individuals destroys any hope of measuring accurately the volume of Nereis by Dr. Gohar's method. From Table IV :

Percentage increase in weight in 25 per cent sea water, specimens *a–f* :

After	4¼ hours :	(*a*) 47 per cent	(*b*)	54 per cent
,,	22¼ ,, :	(*c*) 87 ,,	(*d*)	135 ,,
,,	50¾ ,, :	(*e*) 74 ,,	(*f*)	35 ,,

The body-fluid concentration was measured in terms of the isotonic percentage of sea water. In 100 per cent sea water this lay between 99 and 101 per cent, but in dilute environments the body-fluid was always markedly hypertonic to the surrounding medium. Thus, in the four specimens *c–f*, which had been more than 22 hours in 25 per cent sea water, the body-fluids ranged in isotony from 37 to 42 per cent sea water : that is, 50–70 per cent above the surrounding medium. No attempt can be made here to summarize Beadle's very interesting discussion of the parts played by muscular contraction, nephridial action, etc. ; it is sufficient that the experimental facts disprove Dr. Gohar's prophecy that when the salinity of the environment is changed "the existence of a physico-chemical equilibrium may be foretold".

Since sponges figure first on the list of animals for which "this method is especially suitable", I must point out that from one quarter to three quarters of the volume of a sponge consists of an intercellular jelly, often very watery, the bulk of which must be greatly affected by osmosis ; also in 1895 I figured[3] changes in form of collar-cells in response to changes of salinity and/or *p*H. Measurement shows that they are accompanied by change of volume of the cells.

In 1923 I published[4] a determination of the volume of a preserved *Leucandra aspera* hardened in alcohol. The sponge was weighed in alcohol of different strengths and in water ; I confess that this involved an error similar to Dr. Gohar's, for I now recognize that the hardened cells swell in weaker alcohols and shrink again when dehydration is repeated.

Three years ago, A. G. Lowndes published[5] a very beautiful method for obtaining the volume of living marine organisms, estimating by titration the amount of chlorides in a specific gravity bottle filled with sea water and comparing it with the amount in the same bottle filled with sea water containing a Nereis: the difference gives the amount of chlorides displaced by the Nereis and hence the volume of sea water displaced. The filled specific gravity bottle is in each case weighed, and the difference between the weights is the difference between the weights of that volume of sea water and that volume of Nereis.

Since then, Mr. Lowndes has been kind enough to show me, from time to time, the results of similar measurements in which I was interested. They are remarkably consistent and in his hands the method seems very perfect.

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The Laboratory,
Citadel Hill,
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Feb. 20.

[1] NATURE, Feb. 8, 1941.
[2] *J. Exp. Biol.*, 56–70 (1937).
[3] *Quart. J. Mic. Soc.*, 38, Pl. 2 (1895).
[4] *Quart. J. Mic. Soc.*, 57, 315 (1923).
[5] *Proc. Linn. Soc.*, 62–73 (1938).

Symbiosis in Larval Siricidæ (Hymenoptera)

THE presence of a symbiotic basidiomycete fungus in the adult females of the woodwasp *Sirex gigas* L. was first described by Buchner[1]. Subsequent work by Cartwright[2,3] and Francke-Grossmann[4] has shown that the fungi in this and other species can exist independently and are, in fact, common wood-destroyers. Each egg as it passes into the ovipositor is coated with oidia of the fungus, which grows into the wood in advance of the tunnelling larva and may be the insect's source of food. Francke-Grossmann[4] could find no fungus in the larva, except in the alimentary canal, and decided that the immature female wasp becomes infested by hyphæ growing from the wall of the tunnel into the special intersegmental pouches very soon after the pupal skin is shed.

During a re-investigation of the whole subject, my observations on *S. gigas* L. and *S. cyaneus* F. have confirmed those of the above authors. In addition, fungus has been located in the larva in special organs arising from a modification of the integument on the posterior side of the hypopleural folds on the first abdominal segment. The cuticle is deeply pitted in a characteristic way, and the underlying hypodermal cells are greatly enlarged and probably have a special secretory function. In sections, the fungus can be clearly seen in the pits. The organs were found in a proportion of the larvæ corresponding approximately to the sex ratio of the adults and pupæ cut from the same section of log, suggesting that they are present in female larvæ only. The fungus in these larval organs has been isolated into pure culture and found to be *Sterum sanguinolentum* (A. and S.) Fr.; this species has been shown by Cartwright to be present both in larval tunnels and the intersegmental pouches of the adult female woodwasp.

The significance of these organs in the larvæ has yet to be explained, particularly in relation to the absence of fungus from the pupal stage of the insect. The problems of the part they play in the symbiotic cycle and of their fate during ecdysis are extremely interesting, since the structures are external. The work has now had to be suspended, but an account of the progress to date is being prepared for publication elsewhere.

E. A. PARKIN.

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Forest Products Research Laboratory,
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Aylesbury, Bucks.
Jan. 30.

[1] Buchner, P., "Holznahrung und Symbiose" (Berlin, 1928).
[2] Cartwright, K. St. G., *Ann. Appl. Biol.*, 26, 184–87 (1929).
[3] Cartwright, K. St. G., *Ann. Appl. Biol.*, 25, 430–32 (1938).
[4] Grossmann, H. F., *Z. angew. Ent.*, 25, 647–80 (1939).

Staining of Bacteria and Certain Fungi

THE usual method for staining bacterial and yeast spores requires three operations: the staining of both spores and vegetative cells by applying heat to the slide bearing the dye; the removal of stain from the vegetative cells with a decolorizing agent; and counterstaining the vegetative cells with a dye of a different colour. The same treatment is used to differentiate acid-fast bacteria from others.

A solution has been developed for staining spores and vegetative cells differentially in one operation. Fixed films of bacteria or yeasts are stained for one minute over steam with a solution consisting of malachite green 0·5 per cent, basic fuchsin 0·05 per cent, in distilled water; the film is then washed and dried. Spores are stained greenish blue, other cells violet or, in older cultures, pink. Acid-fast bacteria retain the greenish-blue tinge, and may show the presence of violet granules; all non-acid fast bacteria so far tested are stained violet.

A saline dilution of the staining solution has been developed especially for differentiating the hyphæ and conidia of certain fungi in agar plate cultures.

A paper giving other details will shortly appear in the *Canadian Journal of Research.*

P. H. H. GRAY.

Macdonald College,
Quebec.
Jan. 17.

An American Message

THE Editor and staff of *Bell Laboratories Record* present their compliments to the Editors of NATURE and congratulate them on the continued regularity and high quality of the publication, under extraordinary difficulties. They are happy to report the strong public sentiment here, as to aid for Britain.

PAUL B. FINDLEY.
PHILIP C. JONES.
FRANKLIN L. HUNT.
R. LINSLEY SHEPHERD.
ARTHUR R. THOMPSON.

Four Sixty-Three West Street,
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Jan. 27.

RESEARCH ITEMS

Hungarian Throwing Sticks

POSSIBLE ethnological affinities for a 'casting staff' in use in Hungary some thirty to forty years ago have been suggested by Béla Garda, of the Ethnographical Museum, Budapest (*Man*, Jan. 1941). The Hungarian casting staff was a characteristic weapon of the herdsmen, who were never without them. They were used in fights among the herdsmen themselves or against wolves attacking their herds. Cattle thieves also employed them to drive off anyone attempting to intercept them on their marauding expeditions. The casting staff was a rounded wood cudgel, 65 cm. long and 5 cm. in diameter and pointed at each end, the points being hardened by fire. In throwing, it was held at one end, and it was effective up to 50–100 paces. It appeared first on the Greater and Minor Kunsag of the Hungarian plateau, where a pastoral life was the characteristic condition. Literary references to it are found from the fifteenth century onward. This throwing staff is entirely different from the throwing sticks and boomerangs of European prehistoric and later times. An identical form, however, is found in the Malay Peninsula, in Borneo and Marshall, Gilbert and Yap Islands. Zs. Bátky, the Hungarian ethnologist, is of the opinion that the Hungarian weapon was brought by the Hungarians from the East, its ancient home being the great steppe lands of Asia. In support of this, it is here pointed out that the social organization and civilization of the Hungarian herdsmen show the marked eastern character of the horse-nomads. It is possible, therefore, that the connexion between the casting staves of Hungary and Indonesia-Micronesia may be placed in the same great prehistoric-ethnological culture-frame to which belong the conformities of the Asiatic nomad cultures and of the Oceanic culture of the Farther Indies.

Saxon Relics from Lincolnshire

St. Peter's Church at Barton-on-Humber, North Lincolnshire, one of the oldest churches in England, dates in part from Saxon times; but up to the present, little evidence has been obtained as to the people by whom it was first built. Recent excavations for an air-raid shelter brought to light two or three human skeletons and some pieces of metal which were handed to T. Sheppard of the Hull Museum, by whom the site was visited, and these and later finds are now described (*Hull Mus. Pub.*, No. 208; 1940). It was evident that a number of Anglo-Saxons had been buried just below the original surface, which at a later date had been covered by 5–6 ft. of boulder clay. The bones showed that one body was that of a woman, while another was that of a man of large proportions aged about 45 years. The most interesting find was a large thin bronze bowl with three escutcheons with hooks, each fastened with three bronze rivets; otherwise it is devoid of decoration. It is comparable with other bowls of this type found with Saxon remains, but which T. D. Kendrick has assigned to a Romano-British or British origin. Remains of a trivet with two feet suggest the deposit at Barton of a second bowl of the trivet stand type, but the bowl itself has not been found. Another interesting object was a cylindrical bronze box with a bronze loop, presumably for attachment to a lady's chatelaine. Such boxes were used for carrying sewing or other materials. A long gold bead is unique among Anglo-Saxon gold beads. Extension of the excavation raised the number of skeletons to five in all, and produced a very fine short sword, a set of scales and weights, remains of a bone comb, a large decorated bronze handle and a heavy curved piece of bronze. The scales consist of two plain pans, slightly concave, each 2⅛ in. in diameter, and each perforated for three bronze rings for suspension. The balance beam is of circular bronze wire 5 in. long with zoomorphic terminals, such as have not previously been recorded on balance beams. Beneath each terminal is a loop containing a small bronze ring. From the centre rise two upright pieces of bronze 2 in. in length. Swinging between the two is a pointer of bronze 1 in. in length. Four metal weights ranged from 200·4 grains down to 95·9 grains; other pieces of metal and a Roman coin presumably used as weights from 39·9 grains down to 8·7 grains. A few days after the find of a hanging bowl at Barton, a similar bowl was found at Manton Common, Lincs, while a fine example was found at Caistor in 1857.

Minor Plant Diseases

W. C. MOORE has described three minor plant diseases (*Trans. Brit. Mycol. Soc.*, 24, Pts. 3 and 4, 345–351; Dec. 1940). An angular leaf spot of the apple, previously attributed to the fungus *Phyllosticta angulata* and another species, is now shown to be initiated by an insect, the frog-hopper *Cercopsis sanguinea*. The fungi are there as secondary parasites, but only serve to accentuate a malady already present on the foliage. Leaf spot of lettuce, caused by *Septoria lactucæ*, was observed in Harpenden during the summer of 1940. Infected plants formed hearts, but were very unsightly. Colchicum plants are subject to attack by the fungus *Pythium ultimum*, which is also the cause of watery wound rot in Duke of York potatoes and a rot in tulip bulbs. The disease in Colchicum appears usually during the summer, and indeed some corms are completely disorganized when lifted. Pathogenicity has been established by inoculation with pure cultures.

Origin of Secondary Trisomics

M. M. RHOADES (*Genetics*, 25, 483–520; 1940) has provided cytogenetical evidence that a secondary trisomic involving chromosome 5 of maize arose from an abnormal chromosome which consisted of one arm of chromosome 5 and therefore had a terminal centromere. This terminal centromere is shown to be unstable both in meiosis and mitosis. Transverse division of the centromere during the first microspore division would give a chromosome with a median centromere and two identical arms. Cytogenetical evidence is given of the mode of disjunction in a trivalent and of the linkage group 72 units in length involving 8 genes.

Experiments in Selection

The number of hairs on the ventral surface of the fourth and fifth abdominal segments are inherited as polygenic characters in *Drosophila melanogaster*. K. Mather (*J. Gen.*, **41**, 159–194; 1941) subjected the F_2 of certain crosses to selection for the number of such hairs. In one cross, the greatest change in hair number took place in the first two selected generations. In another cross involving two different stocks, an advance with selection took place in the first two selected generations, followed by a period of stability which was again followed by a considerable advance. By intercrossing the inbred selected lines a greater variation was found in their F_2 as compared with that of the original F_2. This is interpreted to mean that the first advances are due to recombination of independent genes and the second to recombination of linked genes. This presupposes the existence of a balanced combination of genes controlling polygenic characters in one chromosome. Such linked genes will be favoured by natural selection, since the mean expression of a selected variable character will almost coincide with the optimum in the population. Stability of this mean is necessary in the present environment and is achieved by linkage, whereas ability to vary with changing environment is necessary for evolution and is brought about by crossing-over by linked genes. The author therefore accounts for clines in wild populations.

Estimation of Carbon Dioxide in Air

A new method of estimating small quantities of carbon dioxide in air by the absorption of infra-red radiation is described by H. Dingle and A. W. Pryce in *Proc. Roy. Soc.*, B, **129**, 468–474 (1940). Older methods of making this measurement, which is of considerable importance in plant and animal physiology as well as in chemistry, depend on chemical processes or on measurement of the electrical conductivity of solutions in which the carbon dioxide is absorbed. In 1937, however, McAlister introduced a spectrometric method, in which the amount of carbon dioxide was estimated directly from the amount of absorption, by the air under examination, of infra-red radiation near $4\cdot3\,\mu$, the maximum of a strong absorption band of carbon dioxide. The radiation, after passing through the air, was received by a spectrometer set at this wave-length. Dingle and Pryce, however, show that the spectrometer is unnecessary if the air is dried, since the only atmospheric gases which absorb radiation in the near infra-red are carbon dioxide and water vapour. It is therefore necessary merely to compare the total radiation from a bunsen burner transmitted by the air under examination, with that transmitted by a standard quantity of dry air free from carbon dioxide, in order to determine the amount of carbon dioxide present. The amounts of radiation transmitted by the two samples of air fall on two thermopiles connected so that the galvanometer shows the difference in the currents produced. In addition to its greater convenience, this method has three advantages over the measurement at the maximum of the absorption band; it eliminates the cost of the spectrometer, it gives much greater sensitivity since the whole of the transmitted radiation is used, and it is much less affected by variations of temperature, which change the position of the absorption band but do not greatly alter the total absorption.

Surface Effect in Slow Combustion of Hydrocarbons

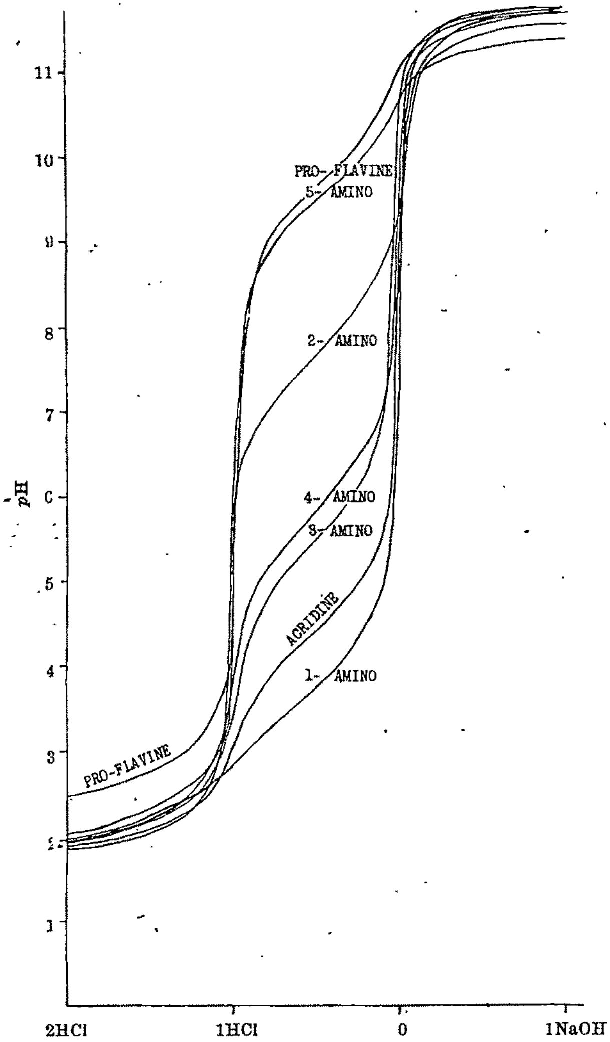
A systematic study has been made by R. G. W. Norrish and J. D. Reagh (*Proc. Roy. Soc.*, A, **176**, 429–48; 1940) of the effect of surface on the slow oxidation of several hydrocarbons, both saturated and unsaturated. Special reaction vessels of approximately constant volume but widely varying diameter were used. All reactions were of the degenerate branching type, and were found to be principally homogeneous in character. When the diameter of the reaction vessel was sufficiently reduced, the reaction rate fell abruptly towards zero, whilst the corresponding induction period increased towards infinity. In narrow vessels, surface deactivation can predominate over other processes of deactivation. In wider vessels, surface and volume deactivation occur to a comparable extent over a considerable range of pressure. The surface deactivation almost alone can suppress the factors leading to chain branching when the vessel diameter is decreased to a critical value. From the reactions studied, the occurrence of this critical diameter appears to be general for hydrocarbon oxidation, in conformity with the theory of degenerate branching.

Motion of Solar Prominences in Three Dimensions

The application of kinematography to the spectrohelioscope has given us, during the past few years of solar activity, some spectacular motion pictures of solar prominences. Outstanding among the institutions engaged in this fascinating work is the McMath-Hulbert Observatory on Lake Angelus, Mich. A further development is now reported from this station (*Publ. Obs. Univ. Mich.*, **8**, 57; 1940): a new spectroheliograph has been designed to give a continuous record of the line-of-sight motions of solar phenomena, particularly of prominences at the limb. The instrument differs from an ordinary spectroheliograph only in the motions executed by the slits in making the record. The first slit is narrow, as is an ordinary entrance slit, and during the recording it scans the prominence image and the adjacent sky intermittently at positions separated by 2 mm. intervals. The second slit is 2 mm. wide and limits the length of the spectrum recorded on the film to 1 mm. on either side of (say) the $H\alpha$ line, which appears in absorption in the light of the sky and in emission in the prominence. The intermittent motion produces a series of such strips placed end to end, and the grid of absorption lines so formed is used to detect at various points in the prominence those displacements of the emission line which are characteristic of line-of-sight motions. In order to facilitate identification of the feature whose radial velocity is being recorded, the wide second slit is automatically narrowed after the intermittent exposure, and a continuous scan then superposes a faint prominence picture on the grid of absorption lines. The whole cycle is then repeated with the first slit moved on, with respect to the solar image, by its own width; and so on until the whole 2 mm. is covered. No part of the prominence, then, can escape the intermittent scan, and on completion of twenty such cycles, a record of the radial velocity at all points on the image has been obtained. Correlation of such records with conventional spectroheliograms taken simultaneously will give three-dimensional pictures which cannot fail to add considerably to our knowledge of prominence motions.

CORRELATION OF BASICITY AND ANTISEPTIC ACTION IN AN ACRIDINE SERIES

THE amino acridines are unique among antiseptics in combining a high bacteriostatic activity in the presence of tissue fluids with a relative innocuousness to leucocytes. Hence any information that relates their physical and chemical properties with their antibacterial action is of general interest. The effect on bacteriostatic activity of varying the positions of amino groups in the acridine nucleus has already been studied in a series of *di*aminoacridines[1] which included the widely used antiseptics proflavine (2 : 8-diaminoacridine) and acriflavine. The contribution of each amino group towards the total effect was therein assessed, thus virtually predicting the antiseptic properties of the five isomeric *mono*-aminoacridines.



POTENTIOMETRIC TITRATION CURVES OF ACRIDINE AND DERIVATIVES

These five monoaminoacridines have now been examined for their antiseptic activity and the results correspond to those predicted. It is noteworthy that two of these simpler monoamines are approximately equal in bacteriostatic effect to the best of the diamines (for example, proflavine).

Further, potentiometric titration of these bases now reveals a remarkable correlation between their strength as bases and their antiseptic activity, the one increasing with the other. The results of these experiments, in which acridine and proflavine have been included for comparison, are condensed in the accompanying table and graph.

These figures represent the highest dilution inhibiting growth after incubation at 37° C. for forty-eight hours (when growth took place in No. 1 dilution, '0' was recorded). All experiments were carried out, in duplicate, according to the method of Garrod[1], which was extended to a wider variety of organisms. The streptococcus was a highly virulent Group A type, the *Staphylococcus aureus* was freshly isolated from a human infection and the *Clostridium Welchii* from a case of gas-gangrene. The latter organism proved the most susceptible of those tested, streptococcus, staphylococcus, *B. coli* and *proteus* following in that order, thus demonstrating a greater activity against Gram-positive types (cf. Browning[2]).

The titrations shown in the graph were carried out at 20° C. by running $N/1$ hydrochloric acid followed by $N/1$ sodium hydroxide into 30 mils of a solution of 0·0005 gm. mol. of the base in 67 per cent methanol.

CORRESPONDENCE BETWEEN BASICITY AND ANTISEPTIC ACTION

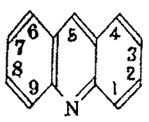
Substance	Medium : Broth *p*H 7·4					Medium : 10% serum-broth *p*H 7·2					Bacteriostatic Index (sum-total of inhibitory dilutions)	*pK* in water*	*pK* in 67% aqueous methanol*
	Cl. Welchii	*Strept. Haem. A.*	*Staph. aureus*	*B. coli*	*Proteus vulgaris*	*Cl. Welchii*	*Strept. Haem. A.*	*Staph. aureus*	*B. coli*	*Proteus vulgaris*			
											Strong antiseptics	Strong bases	
5-Aminoacridine	6	5	3	3	3	7	6	3	3	4	43	9·5	9·34
Proflavine (2:8-diamino-acridine)	6	6	3	3	2	7	6	3	3	2	41	9·1	9·50 (In 50% methanol)
2-Aminoacridine	6	5	2	4	3	7	4	3	4	3	41	8·1	7·60
4-Aminoacridine	4	3	0	1	0	5	2	1	1	0	17	5·5	5·74
3-Aminoacridine	4	3	1	1	0	5	2	1	0	0	17	5·1	5·30
Acridine	3	2	1	0	0	3	1	1	0	1	12	4·3	4·54
1-Aminoacridine	3	1	0	0	0	2	1	1	0	0	8	4·0	3·68
											Weak antiseptics	Weak bases	

* *p*K represents—log. acidity constant (K). $K = \frac{(B)\,(\mathrm{H}^+)}{(B\mathrm{H}^+)}$

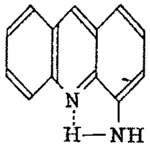
Key to Dilutions : 1 = 1 gm. antiseptic in 5,000 ml. of medium. Similarly, 2 = 1 in 10,000 ; 3 = 1 in 20,000 ; 4 = 1 in 40,000 ; 5 = 1 in 80,000 ; 6 = 1 in 160,000 ; 7 = 1 in 320,000 and 8 = 1 in 640,000.

s solution was contained in a beaker fitted with rer, glass electrode and KCl-agar bridge connected a calomel-half-cell, and a Leeds and Northrup iversal pH potentiometer assembly. Similar results ere obtained when water replaced methanol, but, wing to the base being in suspension, some difficulty was experienced in reaching equilibrium within reasonable time. The acidity constants, calculated rom both sets of results, are compared in the table. It will be seen that, with increasing strength of base, there is a progressive increase in bacteriostatic activity. It appears likely that proflavine and 5-aminoacridine are as strong bases as is desirable, since we have observed that a number of more basic diaminoacridines are equal or inferior to these.

Finally, we have attempted to correlate these great variations in basicity of a series of isomerides with their molecular structure. Acridine, the dissociation constant of which has not been previously recorded ($3{\cdot}4 \times 10^{-10}$ at 20° in 67 per cent methanol; 2×10^{-10} in water) is seen to be a base of similar strength to aniline ($5{\cdot}2 \times 10^{-10}$ at 25° in water) and forming a natural series with quinoline ($1{\cdot}1 \times 10^{-9}$ at 25°) and pyridine ($2{\cdot}4 \times 10^{-9}$ at 25°). The increased basic strengths of 3- and 4-aminoacridines compared to acridine appear reasonable for the addition of an amino group, whilst the reduced strength of 1-aminoacridine is attributed to hydrogen bonding:

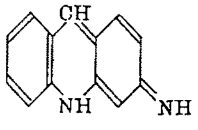


Acridine

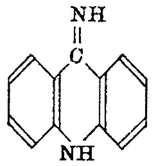


1 Aminoacridine

On account of the remarkably high basicity of the 2- and the 5-aminoacridines, it is preferable to represent these as the tautomeric acridonimines, as follows:



2–Aminoacridine



5 Aminoacridine

and this is consonant with the considerably greater basicity of the imino group compared to the amino group in the guanidine, thiourea, auramine and triphenylmethane series[3]. It is interesting to note that 4-aminopyridine (identical with the middle ring of 5-aminoacridine) is much more basic ($K = 1{\cdot}3 \times 10^{-5}$) than its isomerides[4].

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[1] Albert, A., Francis, A., Garrod, L. P., and Linnell, W. H., *Brit. J. Exper. Path.*, **19**, 41 (1938).

[2] Browning, C., *et al.*, *Proc. Roy. Soc.*, B, **93**, 329 (1922).

[3] Lecher, H., and Graf., F., *Annalen*, **438**, 154 (1924); **445**, 61 (1925). Sidgwick, N. V., "The Organic Chemistry of Nitrogen", pp. 93, 97, 281 and 297 (Oxford, 1937).

[4] Tropsch, H., *Sitzungsberichte der Kais. Akad. Wien*, (2B) **123**, 297 (1914).

ELECTRIC DISCHARGE LAMPS

DR. CLIFFORD C. PATERSON, director of the Research Laboratories of the General Electric Company, Ltd., has written an interesting review of the technical progress made last year in the development of electric discharge lamps (*Electrician*, Jan. 31). Last year he directed attention to the new problems which the 'black-out' has raised so far as general outdoor and shop-lighting are concerned. Except in special instances, these problems offer little scope for discharge lamps. On the other hand, the intensification of the War, while making these outdoor lighting (or darkening) problems more acute, has also created a greater need than ever for high efficiency light sources for our factories and workshops—a need which the existing discharge lamps go a long way to meet.

Mains voltage tubular fluorescent lamps, which follow naturally on the high-voltage fluorescent tubes in use in Great Britain since 1933, were introduced in the United States two years ago, and the demand last year reached several million lamps. The American lamps are made in a range of wattages and colours, particulars of which are given in the following table. The stated efficiencies are high, being 38 L./w. for the 30 w. daylight colour and 45 L./w. for the 30 w. white.

Dr. Paterson gave a general description of these lamps in his review last year, when their introduction in Great Britain was foreshadowed. Although the main programme on tubular fluorescent lamps has been held up in Great Britain until after the War, a special lamp to meet the requirements of war-time industry was put on the market early last year. This lamp, which is rated at 80 w., is 5 ft. long and $1\frac{1}{2}$ in. in diameter. The quoted average life is 2,000 hours, by which time the efficiency has fallen to about 70 per cent of its initial value of 35 L./w., due to the action of the mercury vapour discharge on the fluorescent coating.

U.S.A. MAINS VOLTAGE, TUBULAR, FLUORESCENT LAMPS

Lamp wattage	Length (in.)	Diameter (in.)	Colours
15	18	1	Daylight, white, blue, green, pink, gold, red.
20	24	$1\frac{1}{2}$	
30	36	1	
40	48	$1\frac{1}{2}$	Daylight, white.

The introduction of the new fluorescent lamp is a step of real importance for the illumination engineer and the public alike. A condenser of about 0·05 mfd. is placed across the lamp to prevent radio interference. The power factor correction condenser has a capacity of about 0·75 mfd. and gives an overall power factor of about 90 per cent. When the supply voltage is first switched on by closing the mains switch, the starting switch, which is either thermally or magnetically operated, short-circuits the lamp and allows the filamentary electrodes to heat up. The starting switch then opens automatically, inducing a momentary voltage kick across the lamp high enough to start the discharge.

The tube when alight has a creamy white appearance, the brightness being about 0·5 candles per sq. cm. The colour of the light, which is determined by the fluorescent coating, has been chosen very carefully to give an effect approximating to noon sunlight; the colour-rendering properties are excellent—very much better than those of ordinary incandescent filament lamps. It is not possible to obtain satisfactory colour-rendering by the use of a single fluorescent powder, since all the known powders give bands of light with a well-defined maximum in some region of the visible spectrum, but are deficient in light from other regions. To overcome this difficulty the fluorescent coating comprises a number of different powders, selected so that the peaks of their emission bands occur in complementary regions of the visible spectrum. The proportions of the component powders present in the mixture are adjusted to give the required luminosity distribution throughout the spectrum. The increase in light output due to the fluorescent coating is about 800 per cent. This application of fluorescent powders to obtain high-efficiency sources of white light was first developed in Great Britain in connexion with high-voltage tubular lighting.

Experience gained so far indicates that the new fluorescent lamp has applications in many spheres of industry and commerce, such as fine assembly benches, inspection benches, drawing and general offices, and in any situation where high-efficiency illumination approximating to daylight in its general properties is required. A range of trough reflector fittings, suitable either for high-intensity local lighting or for general lighting from greater heights, is available for use with the lamps.

FORTHCOMING EVENTS

Monday, March 17

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 5 p.m.—Capt. Graham Rowley: "Crossing Baffin Land".

Tuesday, March 18

Royal Society of Arts (Dominions and Colonies Section) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. C. W. Hobley: "Wild Life Conservation in its Wider Aspects."

Wednesday, March 19

Institute of Chemistry (London and South-Eastern Counties' Section) and the **Institute of Physics** (London and Home Counties' Branch) (Joint Meeting), (at the Royal Institution, Albemarle Street, London, S.W.1), at 2.30 p.m.—Dr. J. J. Fox: "Infra-Red Absorption and Molecular Structure".

Thursday, March 20

Royal Society (at Burlington House, Piccadilly, London, W.1), at 2.45 p.m.—Mr. G. E. Briggs, F.R.S.: "Photosynthesis in Intermittent Illumination". Mr. E. C. Bullard and Mr. T. F. Gaskell: "Submarine Seismic Investigations."

APPOINTMENTS VACANT

Applications are invited for the following appointments o before the dates mentioned:

Principal of the Leeds College of Technology—The Director Education, Education Department, Calverley Street, Leeds (March 29).

Demonstrator in Anatomy at St. Thomas's Hospital Medic School—The Dean of the Medical School, Manor House, Godalmin Surrey (March 30).

Part-time Demonstrator in Biology—The Principal, Technic College, Kingston-upon-Thames, Surrey.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Empire Cancer Campaign. Seventeenth Annual Report of the Grand Council. Edited by J. P. Lockhart-Mummery. Pp. 280. (London: British Empire Cancer Campaign.) [52

Greece No. 1 (1941). Convention between His Majesty in respect of the United Kingdom and His Majesty the King of the Hellenes respecting the relations of Learning and Culture between Great Britain and Greece, Athens, December 30, 1940. (Cmd. 6250.) Pp. 7. (London: H.M. Stationery Office.) 2*d.* net. [102

University of Leeds: Department of Coal Gas and Fuel Industries, with Metallurgy. Report of the Livesey Professor (D. T. A. Townend) for the Session 1939–40. Pp. 15. (Leeds: The University.) [102

University of Birmingham. Report of the Vice-Chancellor and Principal to the Council for the Fortieth Session, 1939–40. Pp. 38. (Birmingham: The University). [102

Eleventh Annual Report of the National Smoke Abatement Society. Pp. 28. (Woodborough, Nottingham: National Smoke Abatement Society.) [102

University of St. Andrews. Handbook of the United College. Pp. 30+10 plates. (St. Andrews: The University.) [102

Abstracts of Dissertations approved for the Ph.D., M.Sc., and M.Litt. Degrees in the University of Cambridge during the Academical Year 1939–1940. Pp. 118. (Cambridge: Printed at the University Press.) [102

Other Countries

Records of the Geological Survey of India. Vol. 75, Professional Paper No. 6: Did the Indobrahm or Siwalik River Exist? By Dr. M. S. Krishnan and N. K. N. Ayengar. Pp. 24. (Calcutta: Geological Survey of India.) 5 annas; 6*d.* [52

Memoirs of the Geological Survey of India. Vol. 76, Water-Supply Paper No. 1: The Geology and Underground Water-Supply of Calcutta, Bengal; with Special Reference to Tube-Wells. By Dr. A. L. Coulson. Pp. vi+150+ix+4 plates. (Calcutta: Geological Survey of India.) 3·12 rupees; 6*s.* [52

Indian Forest Records (New Series). Utilization, Vol. 2, No. 2: The Formation of Growth Rings in Indian Trees, Part 2: (a) Champ (*Michelia champaca*); (b) Kokko (*Albizzia lebbek*); (c) Toon (*Cedrela toona*). By Dr. K. Ahmad Chowdhury. Pp. iii+41–58+4 plates. 12 annas; 1*s.* Entomology, Vol. 6, No. 5: New Cerambycidæ from India, 2, Coleoptera. By W. S. Fisher. Pp. ii+197–212. 8 annas; 9*d.* Entomology, Vol. 6, No. 6: New Indian Cerambycidæ (Coleoptera). By J. C. M. Gardner. Pp. ii+213–226. 9 annas; 10*d.* (New Delhi: Manager of Publications.) [52

New Zealand: Department of Scientific and Industrial Research. Geological Memoir No. 5: Metamorphism in the Lake Wakatipu Region, Western Otago, New Zealand. By C. Osborne Hutton. Pp. 90 (17 plates). (Wellington: Government Printer.) 6*s.* [52

Annual Report of the Agricultural Meteorology Section, India Meteorological Department, for the Year 1938–39. Pp. vi+48. (Simla: Government of India Press.) [52

Report on the Administration of the Meteorological Department of the Government of India in 1939–40. Pp. iii+35+8 plates. (Delhi: Manager of Publications.) 1·2 rupees: 3*s.* 9*d.* [52

Publications of the Observatory of the University of Michigan. Vol. 9, No. 4: A Method of Measuring Radial Velocities in Solar Prominences. By Robert R. McMath, with the collaboration of H. E. Sawyer, Orren Mohler and J. Brodie. Pp. 57–60+1 plate. (Ann Arbor, Mich.: University of Michigan.) [52

Catalogue of Indian Insects. Part 25: Thysanoptera. By Dr. T. V. Ramakrishna Ayyar and V. Margabandhu. Pp. iv+64. (Delhi: Manager of Publications.) 2·2 rupees; 3*s.* 9*d.* [52

Sudan Government: Department of Agriculture and Forests. Annual Report, Part 2: Being the Report of the Agricultural Research Service for the Year ended 31st December 1938, relating to Experimental Results obtained in the Crop Season 1937–38. Pp. 124. (Wad Medani: Agricultural Research Institute.) [52

Rainfall in Queensland: Tables showing Monthly and Annual Rainfall Totals at 110 Selected Stations covering all available Years of Record up to and including 1939. Pp. 168. (Crohamhurst: Crohamhurst Observatory.) [102

Observatoire de Zi-ka-wei. Annales de l'Observatoire astronomique de Zô-Sè (Chine). Tome 21, Fascicle 5: Tables des planetes 512, 700, 770, 800. Par le P. E. de la Villemarqué. Pp. 30D. (Zi-ka-wei: Observatoire.) [102

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Vol. 147 SATURDAY, MARCH 22, 1941 No. 3725

FOOD DISTRIBUTION IN WAR-TIME

THE food policy of the Government during the present War has followed three main lines : it has provided for the accumulation of stocks of certain essential commodities against siege conditions ; it has largely prevented profiteering and has achieved a reasonably equitable distribution of food by a system of rationing, by price control and by subsidizing the consumption of certain foodstuffs ; it has also, by special subsidies, as in the case of milk, and by a system of differential prices in the case of margarine, done much to ensure the adequate nutrition of the poorer groups of consumers. It is indeed probable that during the first year of war, with the increase in employment and earnings, and with little diminution in the supply of food, the general average of nutrition was as high, if not higher, than in peace. Recently, however, the position has altered, and it is doubtful if the policy which was successful in 1940 will be adequate for 1941.

The increase in sinkings which occurred in the last quarter of 1940, and the additional calls on shipping resulting from the African campaign, has entailed a revision of the food import programme. "Beef or Bardia" still holds. In consequence, we cannot expect in 1941 to live as comfortably or to eat the same kind of food as we ate in 1940 or before the War. It will be necessary to change our dietary habits, to depend less on meat and more on cereals, potatoes and the cheaper vegetable foods. But if available shipping is directed to the importation of essential foodstuffs, if each prospective cargo is considered in terms of the national health, we shall have enough to eat and remain a fit nation at the end of the War.

The matter, however, does not end with the question of maintaining supplies. The question of distribution is equally important. There must be no unfair distribution of food between income classes. As the food situation deteriorates, unrationed foods increase in importance. When scarce supplementary foods are neither controlled in price nor officially rationed, they will be mainly consumed by those who can afford to buy them. There will be no queues, but the lower income groups will go without. Poultry and canned fruit, for example, provide welcome additions to the diet of the well-to-do, but are little eaten by the poor. Restaurant meals are expensive and are mainly eaten by the rich.

In addition to the difficulty of distribution which inevitably arises in case of shortage, the 'blitz' has introduced problems of its own. When the bombing of London was at its height, too many young men and women, after spending an uncomfortable and exhausting night in a shelter remote from their homes, began their day's work on rolls and coffee because they could not afford a satisfactory breakfast. This condition, if allowed to persist, is likely to have a harmful effect on health and to hinder the national effort.

The problem of food distribution, therefore, resolves itself into ensuring that available supplies are spread over the population in accordance with needs, that the lower income groups get their fair share, and that adequate facilities are provided for feeding elements of the population whose nutrition is likely to suffer as a result of war conditions. Inequalities in distribution, which might be overlooked if other foods were plentiful, become important in a period of general scarcity, and the time appears to have arrived for a revision of the rationing system.

This revision might take one of several forms.

It might be accomplished by introducing the point system, used in Germany, in which each person is given a weekly number of points which are evaluated in terms of different foods. Such a system has, however, the disadvantage that it is highly complicated in operation, and leaves the retailer too much discretion in deciding the food value of different qualities of the same commodity.

Alternatively, a limit could be placed on the weekly *per capita* expenditure on food. The objection to this method is that its adoption might result in the rich competing with the poor for the cheaper foods. This objection has been considered invalid on the ground that, if the rich did compete for the cheaper foods, the more expensive foods would fall in price and would be available to the poor. It is, however, doubtful if this would happen. In the case of certain foods it is more likely that they would go off the market. In the case of others it is likely that the present differential in price, which occurs between, say, high-price and low-price cuts of meat, would disappear, and that the poor would pay rather more for their meat and the rich less.

On balance, it appears probable that the extension of the present system of rationing to essential commodities in short supply is likely to prove more satisfactory than a system of general rationing. In cases where the amount of a commodity to be distributed is small and unlikely to provide an adequate national ration, the introduction of alternative rations might be considered. Eggs or cheese, for example, might be purchased on the same coupon. Also the rationing system should be as flexible as possible in order to admit full advantage being taken of foods which were temporarily plentiful.

It is, however, highly desirable that rationing should be supported by an extension of the present system of providing subsidies for special classes of consumers. The milk scheme which, at certain levels of income, enables free milk to be distributed to nursing and expectant mothers and to children under five, and which provides milk at a reduced price to the same classes, and to school children, whatever the income, is an important step in social progress. The classes to which it applies could, however, be widened in dealing with the distribution of certain foodstuffs.

During war the effect of rising prices is most severely felt by families with more than three children and by the small fixed-income groups, that is, by old-age pensioners, by pensioned widows and orphans, by the unemployed, by the families of men in the Services, and by persons in receipt of public assistance.

These, together with the present beneficiaries under the cheap milk scheme, and families with more than three children, form a substantial part of the population, and are likely to suffer hardship as a result of war. It is therefore suggested that certain foodstuffs in plentiful supply might be provided by subsidy to these classes.

In practice, the subsidy might operate by permitting the purchase of a daily *per capita* allowance of specific foodstuffs at a reduced price. It could apply in the first instance to such things as potatoes, which, compared with bread on a calorie basis, are expensive, to carrots and to green vegetables. It might also be applied to jam, which plays an important part in the dietary of the poor.

The adequate nutrition of the population in war-time, as well as the equitable distribution of food, would also be assisted by providing facilities for communal or collective feeding. Already a certain amount of work has been done in supplying meals in shelters, while the Ministry of Labour and National Service has been given powers to compel the owner of a factory engaged in Government contracts, and employing more than 250 workers, to provide a work's canteen. The efforts have, however, been largely unco-ordinated and spasmodic, and a more systematic approach to the problem is required.

Apart from the obvious economies which would be effected in the cost of materials, and in labour, equipment and fuel, the communal meal enables the right kind of food to be fed to different classes of workers. It makes possible the addition in concentrated form of essential food constituents not present in the original foods.

The provision of communal restaurants near large shelters would have a beneficial effect on the health of the shelter population, while the provision of works' canteens under proper supervision would do much to ensure the adequate nutrition of the factory worker, a problem which will increase in importance as more married women are employed in industry. In the same way, a midday meal in schools would help to safeguard the health of the future generation.

It is doubtful, however, whether any scheme will develop with sufficient speed unless it obtains the more active support of the Government. This support would be most adequately given in two directions: (1) by prescribing minimum standards to be applied to collective feeding and by enforcing these standards by a competent inspectorate; (2) by training and registering staff for new canteens. The scheme might be operated partly by paid and partly by voluntary labour, and organized on a regional basis, linked up with the existing regional organizations. It would then, besides providing an immediate service, be available to undertake emergency feeding in any particular area.

PREHISTORIC COMMUNITIES OF THE BRITISH ISLES

Prehistoric Communities of the British Isles
By Prof. V. Gordon Childe. Pp. xiv+274+16 plates. (London and Edinburgh: W. & R. Chambers, Ltd., 1940). 20*s.* net.

THE study of our prehistoric antiquities has already passed through several phases. The early antiquaries of Tudor and Stuart times are perhaps the most to be envied, for they could travel the country and indulge in picturesque speculation on what they saw, untrammelled by any established body of knowledge. The later eighteenth and nineteenth centuries witnessed the development of excavation, excavation which, while it began to accumulate the factual material necessary for later scientific study, was too often little more than looting to satisfy the collector's instinct and the land-owner's vanity and curiosity. By the beginning of the present century a rickety framework of information had been put together, and the achievement of outstanding individuals such as General Pitt-Rivers already gave promise of the extraordinary blossoming of a truly scientific archæology which took place in the period between two wars. The greater part of this happy period was naturally occupied with the essential preliminary task of extending conventional history backwards by establishing a fixed chronology, tracing invasions, the development of cultures and their interactions. But latterly a new trend was evident. Excavation had become sufficiently widespread, exact and selective to enable some archæologists to be less purely historical and more generally sociological in their approach. Attention began to be focused on the manner of prehistoric life, the structure of early societies, their economic basis and the density of their populations.

Prof. Childe looks through a historian's eyes, but he is far too sensitive to contemporary influence to ignore the new opportunities that were ready to his hand. Hence in this book he undertakes the difficult task of running the two methods, the historical and the sociological, in double harness. The plan of the whole book is historical: after a quick sketch of the first emergence of human societies in Palæolithic times, he follows their evolution in Britain down to the Roman period, with all the tale of invasions and cultural influences and the full archæological panoply of pot- and tool-typology. By dividing the space of time covered by the Neolithic, Bronze and Iron ages into nine parts, he even provides the first modern period-scheme for Great Britain comparable with the classic chronologies of Montelius, Müller and others on the Continent. Yet, throughout, social and economic changes are kept well to the fore, so that the book can with justice claim to be the first "to present a comprehensive account of the development of the societies inhabiting the British Isles in prehistoric times", and it is this aspect which is most stimulating and original.

The adoption of a "neolithic" economy, with agriculture and stock-breeding in place of hunting and food-gathering, must always cause an increase in population, and this fact, together with the soil exhaustion due to primitive agricultural methods, necessitates continual expansion on to new land. It was largely by this means that neolithic culture spread slowly westward from its eastern cradle until at last it reached our shores. Once arrived, this same economic urge dispersed it rapidly over the lighter soils of Britain, wherever simple hoe agriculture could be practised and flocks find open grazing. Prof. Childe makes the interesting point that one among the several distinguishable groups of neolithic settlers, the bearers of the Boyne culture, represent a rather different economy, the line of their settlement being dictated more by considerations of trade in gold and other metals than by those of husbandry. Although neolithic communities were very largely self-sufficing, there was one specialized industry of some importance—the mining of flint and extensive trading of axes made from it—which must have been in professional hands.

Side by side with the full neolithic societies there persisted a rather more primitive native culture which, although it had adopted certain neolithic traits such as potting, was still mainly dependent on the old food-gathering methods, and this element was to re-emerge in the Bronze Age, when for a time the relative importance of agriculture declined.

At the beginning of the Early Bronze Age the invasions of the Beaker Folk introduced a new ruling caste to dominate the old neolithic stocks. These newcomers, who seem to have been pastoral nomads, were able to extend over Britain "a degree of cultural uniformity . . . not repeated until Roman times". Although it would be folly to visualize a "Beaker state", their great holy centres of Stonehenge and Avebury, together with a widespread trade in luxury articles, show a considerable degree of co-operative purpose in both religious and commercial affairs. These Beaker pastoralists could spend the wealth they acquired as exploiting overlords on an improved material equipment; in particular, they provided important markets for the bronze and gold of Ireland, where a precocious knowledge of metallurgy and commerce was due to the tradition of the Boyne culture.

This same knowledge was inherited and developed in the Middle Bronze Age by the people of the so-called Food Vessel culture that grew up in Ireland and in Britain north of the Thames. Apart from their trade, the Food Vessel folk subsisted largely by pastoralism and hunting, and there is no doubt that they represent a reassertion of the old native tradition that we have seen persisting in Neolithic times.

In Wessex a wealthy aristocracy was in power in the Middle Bronze Age whose trade connexions were surprisingly far flung, extending to the Baltic, Central Europe and the Mediterranean. This Wessex society, with its hold upon the best land in the country, was so successful that numbers quickly increased under its rule, and the common folk, distinguished by their cinerary urns, expanded and spread far over England and Scotland and thence to Ireland.

Very important changes took place in the Late Bronze Age. In the first place, there grew up a caste of "international armament manufacturers" in bronze, perhaps detribalized, but wealthy and influential, who may have travelled the land in "veritable caravans", manufacturing and selling their wares. Prof. Childe is at his most interesting when he describes how this caste was ruined by the loss of markets after the introduction of iron.

Another still more significant change that took place later in this period was the introduction of plough tillage with settled fields and steadings, initiating the mixed farming that is still a force to-day.

Agriculture became increasingly intensive when the first iron-using immigrants arrived, and with this went a more developed social organization with nucleated villages as well as isolated farms. A new departure, prompted by the political and military conditions of the times, were the hill-top forts that might be either temporary refuges or tribal centres representing some degree of political unity among the farms and villages of their area.

With the coming of the La Tène Celts in the third–first centuries B.C., a fresh aristocratic class was instituted, particularly in the north of England, where a few ruling warrior families must have been the first patrons of the brilliant artists and skilled craftsmen who created the great British school of Celtic art.

Meanwhile, another group of La Tène Celts had established themselves in the south-west, originally to exploit Cornish tin, but soon spreading farther east and trading in lead, copper and iron as well as tin, and employing for the first time that most important social instrument, a standard currency.

So at last we reach the Belgic invasions of the first century B.C. that come already within the realm of written history. These part-Germanic part-Celtic people whose immigration into Britain is recorded by Cæsar, brought about far-reaching social change. They were ruled by princely dynasties, who established extensive kingdoms with capital cities that were political and commercial centres of importance. At the same time the Belgæ began at last the de-afforestation of the richer soils of England, and the tilling of the good land thus won with the heavy wheeled plough, so introducing the type of agriculture that was to be further advanced by the Anglo-Saxons and to last throughout our Middle Ages. This was the civilization which Claudius found established when he arrived with his elephants to conquer Britain for the Roman Empire.

In thus tracing social development in Britain from neolithic to Belgic times, Prof. Childe has accomplished something new and valuable. He has added solidity and human meaning to the old historical framework, while at the same time keeping the historical depth of perspective. If it is sometimes rather laborious to disentangle this social theme from the mass of archæological fact and description, that is because the author has too much respect for his reader to want him to accept his reconstructions without the evidence upon which they are based. Specialists will notice here and there inconsistencies and errors which can be attributed to the difficulties and haste imposed by war, but they do little to detract from the worth of the book as a whole. Indeed, after reading it, archæologists may well feel proud to recognize how far their work has gone towards recapturing the once-forgotten past of Britain so completely that the old distinction between pre-history and history is becoming more than ever meaningless.

J. J. HAWKES.

A SCHOOL CHEMISTRY

An Introduction to Chemistry

By A. C. Cavell. (1) Part 1 : Inorganic Chemistry. Pp. xiii + 512 + xiii. 6*s*. (2) Parts 2 and 3 : Physical and Organic Chemistry. Pp. xi + 513–712. 4*s*. (London : Macmillan and Co., Ltd., 1940.)

(1) A SPECIAL feature which is claimed for this book is the considerable care which has been taken to separate what the author considers to be necessary for School Certificate examinations and for examinations intermediate between this and Higher School Certificate, the latter material being given, along with historical notes, at the ends of the chapters. This separation does not seem altogether justified. The additional material on Avogadro's hypothesis (which is called Avogadro's law), for example (Chapter ix), would usually be found helpful by elementary students. The course provided, apart from the additions, gives the impression of a minimum one. Practical work and questions from various examinations are given ; in the questions the London General School Certificate examination is very sparsely represented.

The book opens with a historical introduction which is evidently based on good sources, except that Jabir and Geber are confused, as in other places (pp. 257, 310, 344, etc.). The definition of an 'element' on p. 10 is not very satisfactory, since the meaning of 'split', as applied to a substance, is not explained, and the definition of a 'pure substance', as given, would include solutions ; it would be more satisfactory to give the material on pp. 11–12 first. The atomic theory is briefly explained before the laws of combination, which is the historical order. It would have been possible, however, to re-word the definitions of atoms on p. 39 so as to take account of the existence of isotopes (which need not be mentioned) ; as it is, statement (ii), that "the atoms of a given element are identical", is not correct in the 'modern form' of the theory, which the summary claims to give. The author uses 'equivalent weight' for what is now usually called (following Faraday) the 'equivalent', and 'vapour density' is applied to permanent gases.

The theoretical sections are generally clear and adequate, and the order of the chapters is good. The non-metallic elements are dealt with first and the metals follow, after a chapter on electrochemical characters, which are made the basis of classification. This is satisfactory in an elementary course, although it places the metals in a very peculiar order from the point of view of the periodic law. Brief accounts of industrial processes are given. There is a chapter on volumetric analysis at the end, in which the definition of 'normal solution' given on p. 482 is incomplete, and does not agree with that on p. 491.

The style is generally good, but it is surprising to find on p. 482 the direction to 'tip' a solid into a vessel. Revision notes at the end of the book will be useful for reference. There are tables of logarithms and antilogarithms.

A few errors, some of which are common in textbooks, were noticed. It is scarcely correct to say (p. 144) that hydrogen is 'rather inert', since it combines directly with most of the non-metallic elements and with many metals, and reacts with a large number of compounds. The statement that argon was first called 'aeron' (p.118) is new to the reviewer, but may be correct. The eudiometer of Fig. 23 is Ure's, not Volta's, and on p. 160 the name is 'Warltire', not 'Waltire'. The product of oxidation of graphite is graphitic acid, not mellitic acid (p. 190) ; on p. 202 'linseed *oil*' is meant ; and on p. 210 Black's date is 1755, not 1775. On p. 222 the important fact that coal gas owes its poisonous nature to carbon monoxide (which is not stated on p. 227), should be mentioned. Carbon dioxide is usually said to liberate chlorine, not hypochlorous acid, from bleaching powder (p. 255), and since copper evolves hydrogen from hot concentrated hydrobromic and hydriodic acids, the basis of the argument on p. 305 is unsound. Bones are 'burnt', not 'distilled', to make bone-ash (p. 357) ; phosphorus was discovered by Brand, not Brandt, probably in 1674, not 1669, and it was made known by 'Krafft', not 'Kraaft' (p. 361). On p. 387 'Dobereiner' should be 'Döbereiner', and on p. 440 'Wohler' should be 'Wöhler'. The common error that the converter lining is used to dephosphorize the iron in the basic Bessemer process appears on p. 420 ; pure ferrous hydroxide is white, not green (p. 425), and ignited ferric oxide is insoluble in dilute acids (p. 426). Chrome alum does not usually crystallize after twenty-four hours from a solution which has been *boiled* (p. 478).

(2) Parts II and III are claimed to provide an elementary introduction to physical and organic chemistry sufficient for the first year of specialization after School Certificate, and are intended to bridge the 'wide gap' which the author finds between existing books of Certificate and Higher Certificate standards. Practical work is included. The section on physical chemistry (pp. 513–597) is largely concerned with molecular weight

determinations of gases and in solutions, with a short chapter on reaction velocity and equilibrium, and one on atomic structure, radioactivity and valency. The account of equivalent conductivity on pp. 551–52 is too brief to be of much value, and the definition of reaction velocity on p. 570 is incomplete, as it applies only to irreversible reactions. The course in physical chemistry is thus very elementary, but it will probably be adequate for the purpose the author has in mind.

The section on organic chemistry (pp. 598–701) is straightforward, and deals with typical classes of compounds. The old formulæ for glucose and fructose are given on p. 675, and the phenomenon of resonance in benzene is treated on pp. 678–688 as though it were a case of dynamic isomerism, which is misleading.

The book should fulfil the purpose for which it is intended, and it will assist teachers especially in providing some good laboratory work.

A WRITER TURNS FARMER

The Story of a Norfolk Farm

By Henry Williamson. Pp. 403+11 plates. (London: Faber and Faber, Ltd., 1941.) 10*s*. 6*d*. net.

READERS of Henry Williamson's books have long known that some four or five years ago he bought a derelict farm in Norfolk in a district thinly veiled under the pseudonym Whelk-on-Sea, and that he had settled down there with the view of putting it in good order and farming it properly. Few tasks could be more agreeable to a man of adventurous disposition: it involves serious difficulties, both material and human, and considerable financial risks, while failure, if it comes, is regarded as somewhat ignoble or at least in accordance with the forecast of local experts who "told you so". But success has a peculiar satisfaction, and for this men have been prepared to stake a good deal.

All this, and much more, is set out vividly by Mr. Williamson. From the outset he was under no illusions as to the magnitude of the task he had undertaken. In a preliminary look round he learned the local view of the farm; he was warned that this was no time to start farming, least of all for a beginner; he had no knowledge whatsoever of farming, and he took as his chief assistant a relative equally lacking knowledge and experience; and moreover he seems to have felt that he was regarded as lawful plunder by the supposedly simple country folk around. Right from the start he met with a full measure of troubles and difficulties. But he had several qualities to set against all this: a fixed resolve to carry the job through; the energy and enterprise to work himself and not simply to supervise others; he soon learned to manage his tractor, and he had a flair for hitting on the right course of action. Finally, he had the good sense to consult the county agricultural organizer, and fortunately for him Norfolk is particularly well served in this respect.

Of course, it all cost more than he expected, but reclaiming a derelict farm always does, just like restoring an old house. He had also some rather costly experiences with the old tenant and with an old cottager who refused to go. But he was fortunate in being able to continue his writing and broadcasting, and so kept the place going during the lean years.

Much of the book is autobiographical. "In telling the story of the farm," he writes, "I realized that it would be necessary to tell also part of the story of the farmer". These chapters will be particularly appreciated by those who already know and have enjoyed the author's earlier writings. Here he is engagingly candid: "With the exception of the salmon book, which was first class, the last three or four books I had published, while as good as most country stuff, were not much good, although in time students would find delight in finding out about the author, from the pages".

Later he tells of a "weekly nature article" written in an A B C tea shop, and if this is the usual practice of writers of "country stuff" it explains a good deal.

He gives sufficient technical detail for the agriculturist without tiring the general reader. He has much to say about the barley crop of 1938, one of the best in our time, on which, in common with many other farmers, he had counted hopefully; but unfortunately the price was nearly the worst in recent years so that he like many other farmers suffered severely through Nature's bounty.

In 1938 Mr. Williamson lost considerably. But in 1939 prices were better and his accounts balanced; from now on he should have some return until the next slump comes. The farm, however, was always much more to him than a mere money-making concern. He had the courage to refuse an offer of £600 a year for three years for the exploitation of a chalk pit, because this would have spoiled a beautiful part of England.

The book will be read with interest by all who think they would like a farmer's life, for it shows clearly some of the trials the beginner may encounter, and the satisfaction in overcoming them.

E. J. RUSSELL.

THE TORTUGAS LABORATORY

By Prof. K. M. Yonge,
University of Bristol

NEWS has recently been received that the Marine Biological Laboratory of the Carnegie Institution of Washington at the Tortugas Keys, Florida, has been closed owing to necessary restrictions of the Institution's programme in certain directions. The Laboratory buildings have been handed over to the United States Government, that portion of Loggerhead Key on which they stand having been originally leased from the Government for purposes of marine biological research.

The passing of this Laboratory, for thirty-six years one of the few centres of biological research in tropical waters, demands some words of farewell. Its origin is intimately connected with the history of zoology in the United States. Louis Agassiz visited the Tortugas Keys in 1851 in the course of his survey of the Florida reefs, and Alexander Agassiz spent some weeks upon them in 1881. His admirably illustrated report was published two years later in the *Memoirs of the American Academy of Arts and Science*. There is reproduced in "The Letters and Recollections of Alexander Agassiz" by G. R. Agassiz, a letter to Charles Darwin, headed Tortugas, April 16, 1881, in which Agassiz writes of his activities in mapping out the distribution of the corals.

Recollections of this visit must have been uppermost in his mind when Agassiz, in his capacity as a trustee of the recently founded Carnegie Institution of Washington, pressed for the addition of a Department of Marine Biology to its many activities. But he did more than suggest the site for the Laboratory: he provided, in the person of one of his former scientific assistants, Dr. A. G. Mayor, a director who was to control its activities with outstanding success from its inception in 1904 until his untimely death of 1922. It is impossible to think of the Tortugas Laboratory apart from Mayor. His greatest work was done at the Laboratory or on the numerous marine expeditions to the Bahamas and other islands of the West Indies, to Murray Island, Fiji and Samoa, financed by the Department of Marine Biology. His fundamental contributions to the study of Cœlenterates and Ctenophores were largely carried out at the Tortugas.

The wooden laboratory and living rooms were erected near the western extremity of the long sandy island of Loggerhead Key in the summer of 1904. A photograph reproduced in the third Year Book of the Carnegie Institution shows them as they were originally erected, on the bare sand fully exposed to the glaring sun. Visitors in later years were impressed with the wealth of vegetation which surrounded and shaded the buildings. But the coco-nut palms and ironwood trees were planted by Mayor to provide shade and some protection from hurricanes which may sweep with devastating force over this portion of the Gulf of Mexico during the autumn. With the passage of years additional buildings were added, while the capacious M.V. *Anton Dohrn* replaced the auxiliary ketch *Physalia*.

The reefs of the Tortugas form a rough circle, there being the usual sharp descent into deep water on the north-eastern, that is, weather, side. Here the force of the sea driven by the trade winds is too great to permit the formation of a sand key, but shingle ramparts of coral fragments have formed on the inner side of the reef, and in the shelter of these a few mangrove trees find precarious existence. Loggerhead Key lies on the south-west, in the lee of the reef complex, and its shores are buttressed by beach limestone. Other sand keys are scattered about, notably Long Key, which is relatively densely vegetated and provides a nesting place in the summer for hosts of sooty terns and noddies, as well as for the majestic frigate birds which batten on these smaller birds. The entire reef complex was, to me, vividly reminiscent of conditions on the reefs of the Great Barrier of Australia, which are moulded by the action of the south-east trades.

A unique feature is provided by the Marquesas Keys, which lie between the Tortugas and Key West and form an almost perfect ring. They contain no living coral but are formed of calcareous material of mixed origin thrown up above the surface and moulded by the action of the prevailing winds and currents.

The most remarkable feature of the Tortugas Keys is undoubtedly the immense brick erection of Fort Jefferson, which entirely covers one of the sand keys. Successive parties of visiting zoologists used to calculate the millions of bricks which had gone to its construction and the extent of the labour involved in their transport from Key West, seventy miles away. The military value of the Fort appeared problematical, but of its biological value there was, surprisingly, no question. On the piles of the wharf, in the deep shade cast by the crumbling planking overhead, grew corals

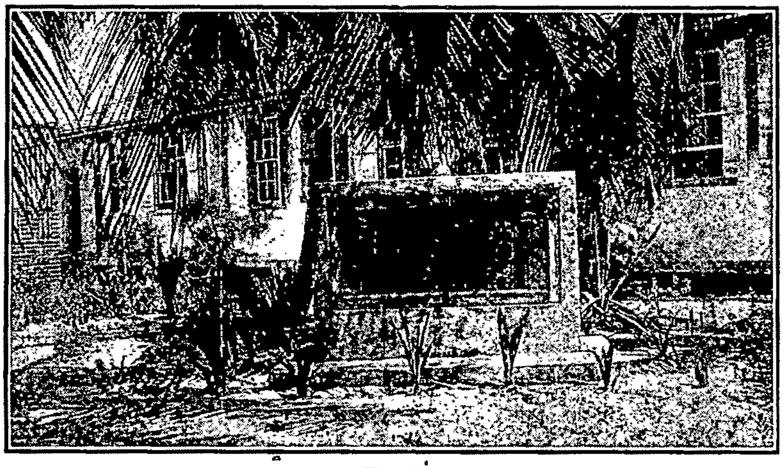

Fig. 1.

MEMORIAL TO DR. A. G. MAYOR AT LOGGERHEAD KEY, TORTUGAS. THE LABORATORY HUT IS SEEN BEHIND.

otherwise obtainable only in relatively deep water. Within the still waters of the wide moat there flourished, within easy access in all weathers, a representative collection of shallow-water corals and other organisms such as *Cassiopea xamachana*, on which much of Mayor's experimental work on Scyphozoa was conducted. During the great hurricane of 1919 the moat, which had stood undamaged for some seventy years, was breached on the north-western side, and further damage was suffered later. The result was to interrupt the previous flow of water through the moat so that those portions which remained filled constituted a sediment trap. A large-scale experiment in Nature was thus provided. A full list of the corals originally present had been provided by Vaughan in 1918 and they included all species typical of the inner reef flat. But when I examined the moat in 1934, apart from a few stunted specimens of other corals, the only common species was *Siderastrea radians*, which exhibited exceptional powers of modification, permitting life both in the surf region and also in still, sediment-laden waters.

It is natural first to consider corals in an account of the work of the Tortugas Laboratory. It was with these organisms and with the reefs which they form that Mayor and his principal associates, T. Wayland Vaughan, L. R. Cary and F. A. Potts among others, were primarily concerned. But the yearly visitors to the Laboratory covered a wide field in marine biology, as will quickly be revealed by reference to the contents of the well-known *Papers from the Tortugas Laboratory*, the thirty-second volume of which is now in course of publication. Mention of the work of W. B. Setchell on marine algæ, of A. L. Treadwell on annelids, of W. H. Longley on fishes, of D. H. Tennant and H. Lyman Clark on echinoderms and of P. Bartsch on molluscs, must suffice to indicate the range and value of this work.

After the death of Mayor in 1922 the Carnegie Institution did not appoint a new director, but Dr. W. H. Longley, of Goucher College, Baltimore, acted as executive officer in charge until his death in 1937, after which Dr. D. H. Tennant, of Bryn Mawr College, continued in the same capacity.

The Carnegie Institution has been most generous in its hospitality and many British workers have enjoyed the unique facilities of the Tortugas Laboratory. It was an exclusively male community, so that activities were never curtailed by any respect for the conventions of dress. One of the larger huts constituted a dormitory which contained a line of hammocks draped with mosquito netting. In the same hut were lodged the library and a laboratory, but a second, more recent, hut contained the principal laboratory and a working aquarium. Two motor-boats kept workers supplied with material, while the *Anton Dohrn* made occasional visits farther afield, as well as regular runs to Key West for stores and mail. The ingenuity and skill of Captain John Mills, engineer and seaman of unfailing energy and high spirits,

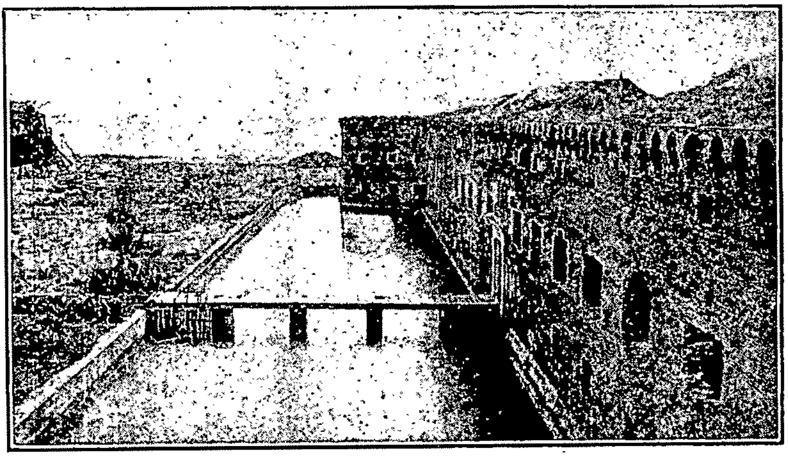

Fig. 2.

FORT JEFFERSON, TORTUGAS, SHOWING A PORTION OF THE MOAT AND THE BRIDGE LEADING TO THE MAIN ENTRANCE.

never failed to provide an answer to all problems of material and experimental equipment.

But for the War of 1914–18 it is possible that the Laboratory might, as Mayor wished, have been transferred to Montago Bay, Jamaica. Direct co-operation would thus have been possible between marine biologists from the United States and Great Britain. One can but hope that this aspect of the manifold activities of the Carnegie Institution of Washington may be resumed in due course, perhaps in collaboration with the Bermuda Biological Station.

CORROSION OF IRON AND STEEL IN SEA WATER*

THE eighteenth report of the Committee of the Institution of Civil Engineers on the Deterioration of Structures of Timber, Metal and Concrete exposed to the Action of Sea Water contains the final results of the fifteen years exposure of iron and steel specimens in the four harbours named, and also summarizes the results, previously published, of the five- and ten-year series. The observations on ferrous specimens are therefore now complete. Although the total number of bars exposed was large, only three of each material were exposed in each position, one of the three being removed at the end of each five-year period, so that there were no actual duplicates. It follows that accidental differences have a rather large effect, and it is only possible to make roughly quantitative comparisons, best expressed in graphical form. Naturally, wide differences were found between the results at different stations, partly on account of the prevailing temperature, but also owing to local circumstances. Thus, at Colombo the rise and fall of the tide is small, so that the half-tide specimens, being for most of their time in contact with water, were more nearly comparable with completely immersed specimens at other stations, and the bars exposed to the air were so often wetted by spray as to be comparable with half-tide specimens elsewhere.

All bars in this series of experiments were unpainted, but several materials were tested in two conditions: with adherent rolling scale and after removal of scale. The scale affords only temporary protection, and when flaking begins deep pits may be formed; so that although a scale-bearing bar may show a smaller loss of weight than its companion with the scale removed, it may actually be in a worse condition. Complications also arise from the accumulation of marine growths. In some instances this has led to a falling off of the rate of corrosion in the last five years of the test, the adherent growth being protective. On the other hand, considerable pitting may be found under the marine organisms.

Considering the materials in detail, cast iron behaved well in air, but when submerged was very liable to 'graphitization', the outer form being retained but the interior being converted into a spongy mass without strength. High-alloy steels of the austenitic type showed, as might be expected, a much higher resistance than carbon or low-alloy steels, but the cutlery type of stainless steel was less satisfactory when immersed in sea water. Such materials, from their high cost, can only be used in exceptional circumstances. Of the low alloy steels, those containing copper behaved well when exposed to air, but less well in sea water.

For practical purposes, mild steel and wrought iron are the most important ferrous materials, and it is this section of the report which will receive most attention. Using a system of averaging the results which was adopted after consideration, the numbers being too small for statistical treatment, it appears that under aerial conditions mild steel is less corroded than wrought iron of high quality; in fresh water there is little difference; and in sea water the wrought iron has the advantage. Some remarks on the effect of impurities in steel call for comment. The steel with high sulphur was also high in phosphorus, and the discussion seems to imply that the influence of these two elements would be in the same direction, which is unlikely. There were no specimens in which sulphur and phosphorus were varied independently.

On the whole, the results of these extensive field tests, carried out over a long period and with careful planning, are very much what might have been expected. The work of the Committee has, of course, covered much more ground than that of the present report, as it included both timber and concrete structures, as to the resistance of which to marine conditions there was much less information available. Of iron and steel it may be said that the inherent resistance of the ordinary varieties to marine corrosion does not vary very widely and that some form of protection is nearly always essential. Much more work on the nature of the corrosive process is needed, and is now actively in progress.

C. H. D.

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* Deterioration of Structures of Timber, Metal and Concrete Exposed to the Action of Sea-Water. Eighteenth Report of the Committee of the Institution of Civil Engineers: Being a General Discussion of the Results of the Corrosion Tests carried out with Ferrous Specimens for 5, 10 and 15 Years at Auckland (New Zealand), Colombo (Ceylon), Halifax (Canada) and Plymouth (England). By Dr. J. Newton Friend. Edited by H. J. Grose. Pp. iv+52+9 plates. (London: Institution of Civil Engineers; William Clowes and Sons, Ltd., 1940.) 8s. 6d.

THE BANANA IN CENTRAL AMERICA

II. THE CONTROL OF CERCOSPORA LEAF DISEASE

BY PROF. C. W. WARDLAW,
UNIVERSITY OF MANCHESTER

THE leaf spot disease of bananas caused by *Cercospora musæ*, Zimm., though widely distributed in the Indo-Malayan and Australian regions, was not recorded in the western tropics until 1934. During the brief period of two or three years from its first recognition in Trinidad[1], it had appeared with epidemic intensity in many of the Caribbean islands and on the mainland of Central and South America, and by its destructive effect on plantations showed itself to be a disease of first-class economic importance. In the Republic of Honduras, where successful control measures were eventually worked out, as described below, the disease was first definitely recognized towards the end of 1935, at which time the intensity of infections suggested a development period of perhaps twelve to eighteen months. The data available, unfortunately, throw little light on the question as to how this malady was introduced into the Caribbean or whether its spread took place from one or several centres of infection.

Briefly, the disease manifests itself as a profuse spotting of leaves ; the tissue around the spots begins to die rapidly, and large, coalescing dead patches appear, so that in severe infections the leaf may be more or less completely destroyed. Bunches borne on affected plants show slow or arrested growth, behave abnormally during development and subsequent ripening, and commercially are valueless[2].

The success eventually achieved in Central America in controlling leaf disease is to be viewed in relation to previous work undertaken in Australia. The literature up to 1935 shows that no control measures had, in fact, been worked out[3]. In particular, dusting and spraying with fungicides had not met with the desired measure of success. Removal of infected leaves, fungicidal treatment of suckers, different spacings of plants and the growth of cover crops, all yielded results which were either negative or uneconomic.

When Cercospora leaf disease became established in the vast banana plantations in Central America, the economic losses, within a very short time, were formidable, and it was evident that some measure of control *must* be secured if a major agricultural disaster was to be avoided. Only those who have ridden for hours through miles of scorched, brown plantations, with extensive defoliation in progress, and everywhere small worthless bunches ripening on the plant, and who, by contrast, have seen the leafy greenery of a first-class plantation in full production, can appreciate the havoc wrought by this new malady as it waxed to epidemic proportions.

Here indeed was a challenge. The scientific staff of the principal fruit company spared neither labour nor expense in an effort to determine whether or not thorough dusting or spraying, repeated as each new leaf appeared, would give protection against the disease. For it should be noted that a monocotyledonous plant such as the banana, which produces its complement of some twelve to fifteen large leaves one by one at intervals of two to three weeks, according to growth conditions, presents a problem of unusual difficulty when it is a question of securing adequate spray coverage on a majority of the leaves. The work of Stahel[4] on *Cercospora musæ* as it affects the Congo banana in Surinam had shown that only the young leaves in the centre of the foliage crown were susceptible, and hence, for thorough protection, each new leaf should be sprayed as it emerges from the top of the pseudostem and begins to unroll. Actually, more recent investigations have shown that the older leaves of the Gros Michel are also susceptible ; but this only adds to an already exacting task and justifies the present procedure in Central America of spraying plants right through to the harvesting of the bunch. The problem confronting banana growers, then, was twofold, namely, the application of dust or spray fungicide over vast acreages, and the frequent treatment of plants of all ages throughout the year. Truly a formidable task and one, moreover, to which it seemed improbable that there could be an economic solution.

As the programme of experimental work was steadily pursued, the epidemic took an ever-increasing toll of plantations, and it was evident that the industry was faced with the most serious crisis of its history. Or, as one writer, with characteristic Latin-American emphasis, put it : "Leaf disease has made a dwarf of Panama disease". At length it began to be apparent, though final confirmation was far from having been obtained, that by spraying plants in short cycles of two to three weeks, that is, as new leaves emerged, with Bordeaux Mixture and other copper-containing preparations, a considerable measure of protection against leaf spotting was achieved. At this point the whole situation had become so critical that it seemed desirable that action should be taken on the preliminary results obtained, and the courageous decision was reached to install stationary spraying apparatus on a gigantic scale, the equipment to include power-houses, large spray-mixing tanks, pumping units and the materials for an ample pipe-line system extending right through the plantations. It was eventually found that a block of seven to eight hundred acres made a satisfactory unit for a single spraying 'project', several such units being necessary on each large banana division. On the Ullua River (Republic of Honduras) there is to-day a continuous area of 36,000 acres (about 60 square miles) under permanent pipe-line spray control. Altogether, in Central America, more than 100,000 acres are now equipped with stationary installations. Once again, the industry is in a state of high productiveness, and notwithstanding the heavy expenditure on spraying equipment and on the machinery for overhead irrigation, good profits are being made. The control of leaf disease probably represents one of the greatest achievements in the history of phytopathology.

Fig. 4.

BANANA PLANTATION IMMEDIATELY AFTER DUSTING BY AEROPLANE.

Before proceeding to an account of the equipment and its manipulation, reference may be made to the subject of fungicides. Many have now been tried and in various degrees have been found to possess practical value. By all tests and criteria, however, experience in Central America has consistently pointed to Bordeaux Mixture as the most satisfactory fungicide for the control of leaf disease.

Reference may also be made to dusting by aeroplane. Briefly, spray has proved superior to dust: the latter is quite expensive and does not give the same certainty of control as spraying does. In practice, dusting by aeroplane is rather a tricky business, and, moreover, the period each day when applications can usefully be made is very brief; that is, in the early morning while dew still remains on the leaves. Dusting by aeroplane probably has its place, however, in those areas where the extent and duration of productiveness

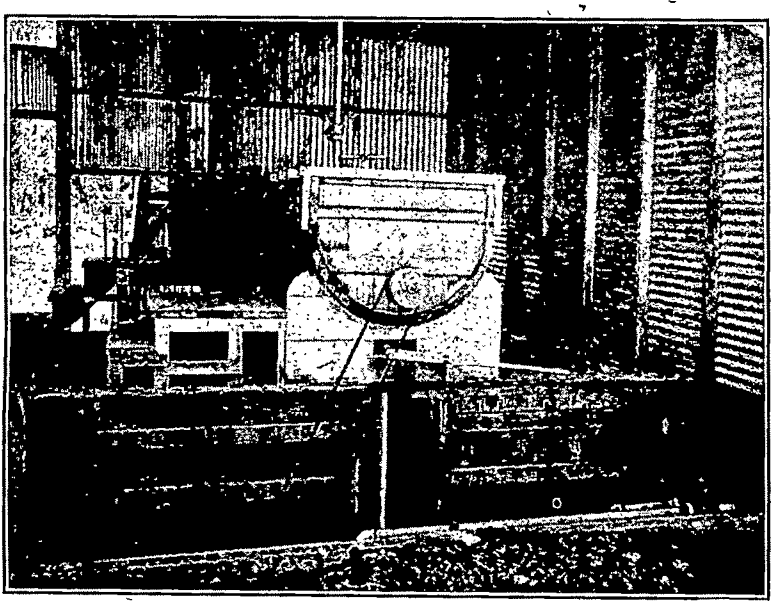

Fig. 5.

PREPARATION OF BORDEAUX MIXTURE. THE TWO LARGE MIXING TANKS (EACH 2,000 GAL. CAPACITY) WITH THE LIME DEGRITTER ABOVE. IN THE BACKGROUND THE COPPER SULPHATE TANK CAN BE SEEN.

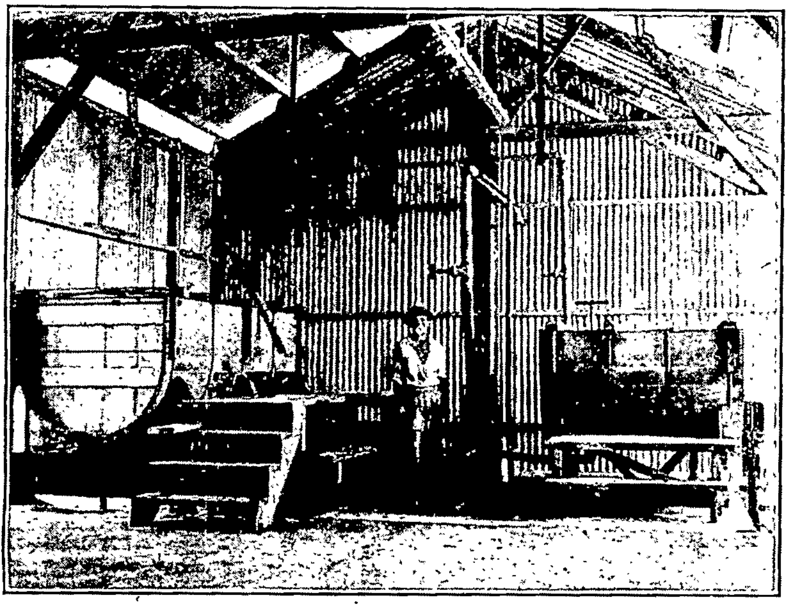

Fig. 6.

INSIDE THE MIXING SHED. THE OPERATOR IS STANDING ON THE PLATFORM ABOVE THE LARGE MIXING TANKS ; RIGHT, THE LIME DEGRITTER ; LEFT, THE COPPER SULPHATE SOAKING TANK.

do not warrant the installation of permanent, stationary equipment.

It should also be mentioned that the methods of cultivation used in plantations in Central America largely, if not entirely, preclude the operation of mobile spraying units, since the plantation floor is strewn with decaying stumps and logs, is rough and irregular in the absence of mechanical tillage, is overgrown with vines and shrubby vegetation, and is dissected by deep drainage ditches and in some instances by irrigation canals.

The spraying equipment, which now constitutes such a characteristic feature of banana plantations, has been derived, with modifications dictated by experience, from that used in United States orchards. Driving power for the pumps and mixing tanks is provided by a 40–50 h.p. Diesel engine. A spray pump, of the three-cylinder vertical type, with a capacity of 60 gall. min., at 600 lb. pressure and a speed of 120 r.p.m., has been found adequate for an 800-acre block operating on a 14-day spraying cycle. It may be noted that the high pressure under which the spraying fluid is maintained is of the greatest importance in providing a good coverage. Side by side with the power house is the mixing house where the spray is prepared. Bordeaux Mixture having come into general use as the most effective fungicide, the equipment of the mixing house has been specially designed to make its preparation as simple and efficient as possible. The two main mixing tanks, each of 2,000 gallons capacity, are provided with four propeller agitators with a central bearing. The warehouse floor, tank tops, and the floor of the railway car (in which materials are delivered) are all on the same level, thus facilitating the handling of materials and economizing labour. Situated above the two large tanks is a smaller tank described as a lime degritter (Fig. 5). Of approximately 300 gallons capacity, it is provided with an agitator which can easily be started and stopped. In this tank the proper quantity of lime is mixed with 250 gallons of water and vigorously agitated for as long as possible. Then, before use, during a period of five or more minutes, the grit is allowed to settle and the milk of lime drawn off through a 2-in. pipe which projects some three inches above the bottom of the tank. The copper sulphate solution is prepared in another tank which is divided into four compartments each of 200 gallons capacity (Fig. 6). Each compartment is fitted with a tray which holds the bluestone and

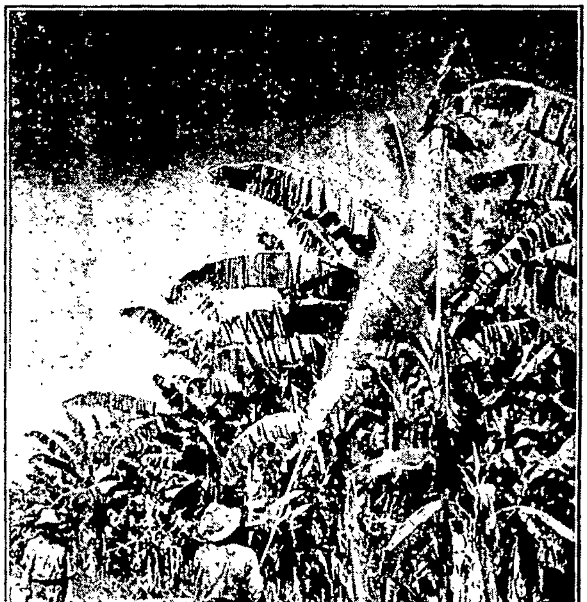

Fig. 7.

SPRAYING PLANTS OF MEDIUM STATURE.

descends some four inches into the water. For 2,000 gallons of spray of standard strength (that is, 5-5-50), 200 lb. of copper sulphate would be placed in one of the trays ; at tropical temperatures this quantity will dissolve in about two hours. Mixing can be continued indefinitely by using the soaking tanks in rotation. The charge of copper sulphate solution is led into the large mixing tank through a 1·25-in. brass pipe, header and rubber hose. In Honduras, the method used in the preparation of Bordeaux Mixture is to add dilute copper sulphate solution to concentrated milk of lime. The latter is therefore run into the mixing tank, and the former, diluted to the required extent in a swirl box by the addition of water from a 3-in. hose, is added.

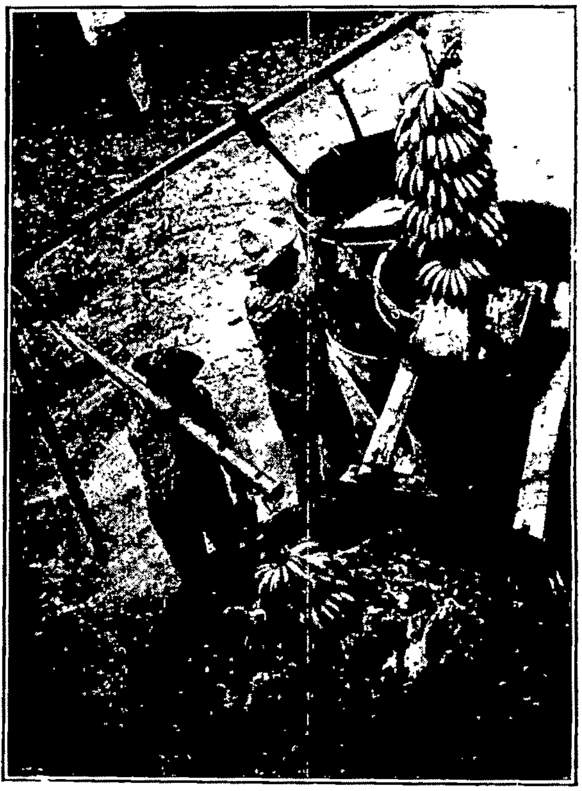

Fig. 9.

Removal of spray residue. The nearer bunch is being dipped in the acid bath ; the further bunch is being drained before going into the water baths.

The pipe system used for the distribution of Bordeaux Mixture from pump house to plantation consists of 2-in. mains, 1·25-in. laterals, and 0·75-in. sub-laterals, all suitably galvanized. An economic and effective layout of pipes is designed separately for each project. As an indication of the scale of a typical unit it may be mentioned that main lines may extend to 10,000 ft., laterals to 4,000 ft., and sub-laterals to 800–1,000 ft. The spacing between sub-laterals may range from 160 ft. to 240 ft., this being determined by local factors such as the position of open drains and the conditions of the plantation floor. The actual installation of these extensive pipe-line systems has been accomplished by quite inexperienced labour, recruited locally. The pipes are simply laid on the ground. As to the very considerable detail relevant to mechanical aspects, blockages, deterioration, etc., it need only be said that each and all are the subject of careful study, and that a special repair and maintenance squad is constantly at work, supervising, testing and where necessary effecting desirable changes. The actual distribution of spray is by means of hoses ; these are attached to the delivery pipes and dragged here and there over a limited area as required (Fig. 7). Eight to ten hoses may be in operation in one small area, and each spray gun may be opened and closed several times per minute. In these circumstances it is evident that very rapid changes in pressure may take place in the system : the undesirable effects which would normally result have, however, been satisfactorily overcome by the insertion at suitable intervals of vertical stand pipes (Fig. 8) ; these are 3 in. in diameter and 4 ft. high ; the air cushions which they provide reduce water hammer and effect a balancing of pressure at the delivery nozzles.

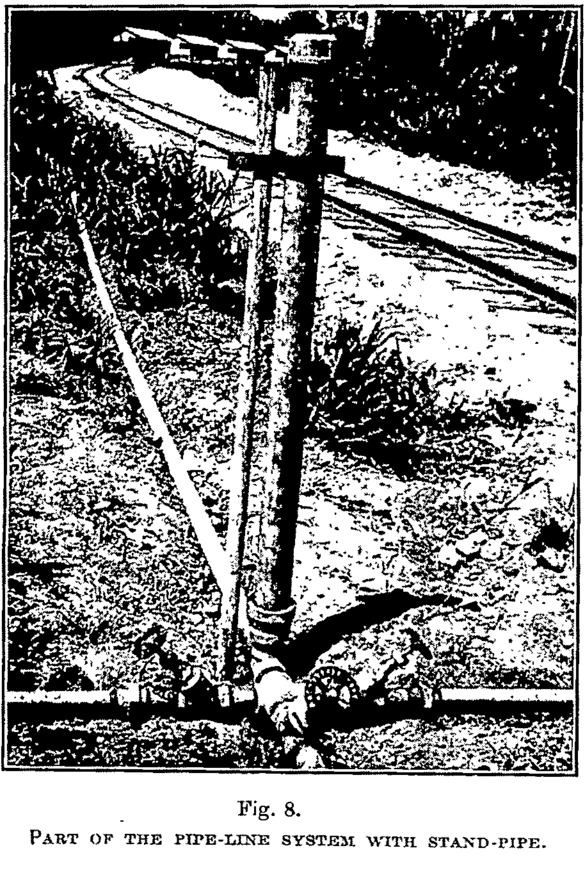

Fig. 8.

Part of the pipe-line system with stand-pipe.

Spraying operations are carried out by local labour. Members of the spray gang are always conspicuous by the whitish blue deposits of Bordeaux Mixture on their hats and shirts. They take a great pride in their work and describe themselves with all due solemnity as 'chemists'. The effective spraying of bananas is not an easy task: every stool includes plants of three ages (that is, the oldest plant bearing a more or less well-developed bunch, its immediate successor, also a tall plant, and a still younger follower); and there may be as many as 300–500 stools per acre. To lack of uniformity in the height of plants to be sprayed is added a further difficulty in that in plantations more than five or six years old the plants are very irregularly distributed. The leaf itself offers still further obstacles in that its waxy surfaces, vertically or steeply inclined when young, are not easily wetted. Nevertheless, all these difficulties have been overcome. Each stool is thoroughly sprayed from four positions, the jet being directed just below the top of the highest leaves (30–40 ft. above the ground), the lower leaves being adequately wetted by the downwardly drifting spray. Details of the construction of spray guns need not be entered on here; the essential point to be noted is that, at the high pressures used, the Bordeaux Mixture is applied as a veritable fog, the coverage afforded being surprisingly good and very effective. At the end of each day's work, the pipe-line system is washed out and left full of clean water.

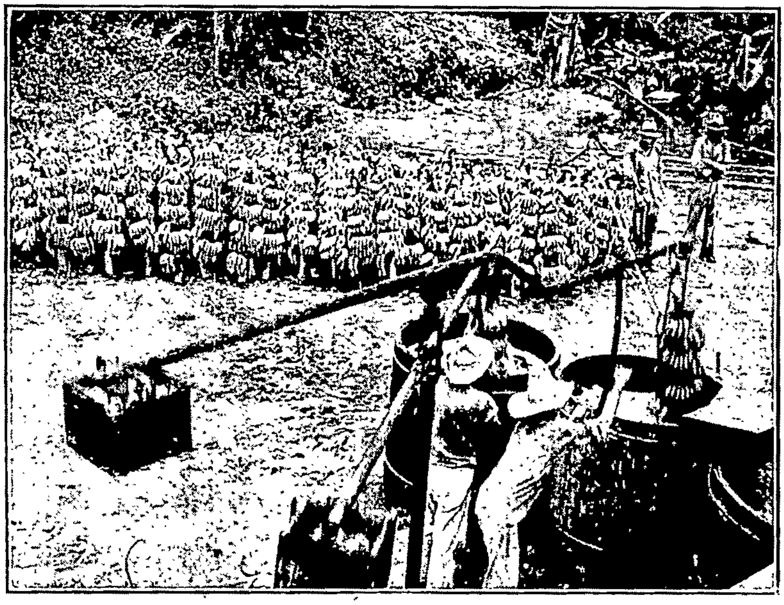
Fig. 10.

SCENE AT FRUIT DEPOT. THE COUNTERPOISE APPARATUS FOR DIPPING BUNCHES IS SEEN IN OPERATION.

The use of Bordeaux Mixture necessitates the removal of the spray residue from the fruit. This is effected by dipping freshly harvested bunches in a dilute acid bath followed by thorough washing in water—a procedure which removes the detritus accumulated during growth and therefore improves the appearance of the fruit (Figs. 9 and 10).

Installation, operation and maintenance have been the subject of careful costing. The control of leaf disease, involving as it does continuous spraying throughout the year at intervals of two to five weeks, is, of course, expensive. Nevertheless, experience has shown that the costs can be met and that considerable profits can be made. Most important of all, an epidemic disease which threatened a major industry with extinction has been conquered—an achievement which must be highly gratifying to those who have been associated with this notable phase of tropical agriculture.

The control of leaf disease has many aspects. A few of these may be briefly noted here. While leaf disease can be controlled by the application of copper-containing sprays, knowledge of meteorological conditions, rate of development of leaves, and of the seasonal intensification of the disease is necessary in order that control measures may be undertaken at minimum cost. In fully grown plantations, the control of severe leaf disease is difficult and costly, and, as a rule, requires a considerable period of time to achieve. Experience has shown that the best procedure is to cut down all plants in affected areas and to secure control as the young plants come up. Considerable difficulty has been experienced in obtaining control in young plantations situated in close proximity to severely affected areas; instances are known where control could not be obtained until the adjacent diseased plantations had been cut down. Since adult leaves as well as young ones are susceptible, it is considered advisable to spray the entire stool thoroughly on each occasion, continuing through to the harvesting of the bunch. Good spray coverage means good control; the best coverage is obtained when properly prepared spraying liquid is applied under high pressure. In regions where growth is rapid, control is sometimes difficult to obtain; a close spraying cycle is then necessary, and should only be widened when sufficient knowledge of the local behaviour of the disease has been obtained. Spraying makes for an increase in the bunch weight, but injury due to scale insects is intensified. Pruning of spotted leaves not only serves no useful purpose but even accentuates the effects of the disease. The fact that bad areas must in some instances be cut down before control in adjacent areas can be obtained is an indication of the important part played by the locally produced spore population.

Satisfactory as the position now is in respect of commercial control, it is generally admitted that costs are still too high, that many aspects of the disease, including the effect of soil and climate, are still imperfectly understood, and that research work on a comprehensive basis should be consistently pursued.

[1] Wardlaw, *Trop. Agric.*, 11, 7, 173-175 (1934).

[2] Wardlaw, Leonard and Barnell, *Trop. Agric.*, 16, 6 (1939).

[3] Wardlaw, "Diseases of the Banana" (Macmillan), Chap. xv. (1935).

[4] Stahel, *Trop. Agric.*, 14, 9, 257-264 (1937).

OBITUARIES

Prof. Vito Volterra, For.Mem.R.S.

VITO VOLTERRA, who died on October 11, 1940, was the best known of the many fine mathematicians whom Italy has produced in our time. He knew everybody and went everywhere. He was a member of every academy from Leningrad to Washington. One found him lecturing now at the Sorbonne, now at Princeton, now at Prague and now at Madrid. He was a great personage in Rome for many years, professor at the University, member of the Senate, president of the Lincei; he had his hospitable flat in the Via in Lucina near the Piazza Colonna, and his Villina Volterra at Ariccia on the Appian Way. But like many another Italian scholar, he failed now and then to see eye to eye with his Government; his family were more incautious than he, and troubles came to them and to him; but he worked on to the end.

Volterra was born in or near Pisa, in 1860, and became a professor at an early age in that little Tuscan university; later on he went to Turin, and thence to Rome. His first papers were physico-mathematical, on statical electricity, elasticity, optics. But when he was twenty-seven he wrote a long paper on linear differential equations, following it up by a second part five years later; and these two papers were the foundation of his career. They lasted so well that he republished both of them in 1938, fifty years after they first appeared, the one with little change the other with none at all, as the first fifteen chapters of his last book in Emile Borel's series, on "Opérations infinitésimales linéaires". Volterra was soon famous for his skill in differential equations, and for the ingenious uses he put them to. By the time he was fifty, the Royal Society made him a foreign member, the French Institute did the same, and other honours fell thick upon him. In 1913 he wrote his "Leçons sur les équations intégrales et les équations intégro-différentielles", for his friend Emile Borel; he had spoken on the same theme to the Cambridge Mathematical Congress of the year before. Many similar books followed, some in Borel's series, some published elsewhere, and all are still in use. The last of them, published with M. B. Hostinsky's help less than three years ago, is the one which harks straight back to his youthful essay of 1887.

That differential equations have become vastly important to physical science is not all Volterra's doing, but he has done a lion's share. He used them in one of his early papers (in 1898) in the study of seiches, which Forel had been observing in the Lake of Geneva, which Chrystal was to study soon afterwards at Loch Earn, and which Proudman has since studied by methods similar to Volterra's. Even before this he had applied his equations to elastic torsion, magnetic hysteresis, and certain other phenomena which he liked to call "hereditary", because they involve the past history of the system. He lived to see his methods and his equations used in the most diverse fields, in connexion with matrices, in Smoluchowsky's study of the Brownian movement, in the theory of probabilities, even in economics and statistics.

Differential equations crop up of themselves in the study of natural selection. Volterra's daughter Luisa had married Dr. Umberto d'Ancona, then a young zoologist, now a leading authority on Mediterranean fish and fisheries; and Volterra was led to apply his mathematics to the struggle for existence among fish. The story begins with an imaginary sea inhabited by sharks and codfish, the devourers and the devoured: with the result (of which Herbert Spenser had caught more than a glimpse) that the two species increase and diminish by turns, in waves which never damp down to equilibrium. Volterra developed the subject in a great many papers. He brought it before the Oxford meeting of the British Association in 1926; he discussed it with the International Council for the Exploration of the Sea at Copenhagen in 1928; he gave lectures on it at the Institut Poincaré, and published them as "Leçons sur la théorie mathématique de la lutte pour la vie" in 1931. He revised and epitomized the whole matter at the Mathematical Congress in Paris in 1937; and here (if not before) he brought out the curious proposition—he called it a *paradoxe démographique*—Si l'on conserve sans altération les coefficients d'accroissements des espèces, une seule exceptée, la moyenne de la population de cette espèce ne changera pas, tandis que les moyennes des populations d'autres espèces changeront. An early abstract of this work of his had appeared in NATURE (I translated it for him) on October 16, 1926, p. 558.

Volterra went much farther in his later papers. He found in biological variation an analogue to Hamilton's principle in mechanics, with Maupertuis's principle of least action not far behind. He reduced the fluctuation equations to a Jacobian partial differential equation, and obtained the corresponding integrals. It is unlucky for us biologists that such paths go smoothly for a while, but then soar to heights unclimbable. Prof. Kostitzin's little book, "La biologie mathématique", for which Volterra wrote a preface, and which was reviewed at length in NATURE (of June 5, 1937, p. 943), is enough to show the range and the ultimate complexity of the biological problems. Volterra was not the first in this fertile field. He was forestalled, though he did not know it, by Ronald Ross's "Malaria Equations", by some of W. R. Thompson's studies of insect parasitism, and fully and precisely by A. J. Lotka in his "Physical Biology" (1925) and earlier papers. How much Volterra added of his own is not always easy to say, but he toiled over the subject, and enlarged and clarified it. D'ARCY W. THOMPSON.

VOLTERRA'S fundamental ideas have enriched many branches of mathematics. Most of these ideas can be traced back to his earliest papers, and originated in attempts to solve physical and mechanical problems. Though his books, and especially their titles, might suggest that he was primarily a pure mathematician, his thoughts never ceased to be active with problems of the actual world; he was not content with having devised elegant solutions of problems of applied mathematics, until the result had been tested by measurements on models or observations of the natural phenomena concerned. In his work on elasticity, for example, he made many clever experiments on rubber models, and his pupils or colleagues supplemented these experiments by others in which they used the double refraction method to measure internal strain. Again, in discussing heat flow in the earth, he applied his calculations to the St. Gothard tunnel, and pointed out the practical importance of the theory in tunnel boring. A paper he wrote on the Hall effect was followed by similar observations to test the influence of a magnetic field on the resistance of a metal plate.

Among his most important work was that on integral equations with variable limits, which originated in 1884 from a problem in electrostatics. He pointed out the analogy with limiting systems of algebraic equations, and in 1896 developed an elegant solution in terms of iterated kernels. Later he applied his methods to multiple integrals and partial differential equations.

So early as 1887 Volterra introduced the conceptions of 'functions of lines' (or rather curves) and functionals, and in later years developed a calculus of functionals that proved to be of great value in treating integro-differential equations, such as arose in his theory of 'hereditary' phenomena in physics and biology.

Volterra also showed how to apply Green's theorem in n dimensions to extend Riemann's method of characteristics so that it could be applied to solve boundary problems for linear hyperbolic partial differential equations in n independent variables. In particular, he discussed the cylindrical wave equation, and found the appropriate analogue of Kirchhoff's theorem on wave motion. The idea was also modified to suit systems of equations that occurred in his researches on wave motion in elastic media, and to parabolic equations. He constructed a theory of the differential and integral calculus of substitutions in connexion with the theory of ordinary linear differential equations, and showed that Fuchs's results could be interpreted as an extension of Cauchy's theory of residues. S. CHAPMAN.

Miss Bertha Porter

THE gifts of mind and character which, though they may fall short of brilliance, ensure that the holder, unless met by too adverse a fate, will presently find an opportunity for free development and fruitfulness, should be given high rank in a hierarchy of service. Amongst such souls Bertha Porter may be assigned a place.

Born at the end of the early Victorian period to the home of a successful architect in whose house in Russell Square many highly cultured men and women might be met, Bertha Porter early showed a keen interest in knowledge as such, and, after her short school-time at Bedford College was over, pursued this and that with diligence. This mental alertness, combined with methodical habits and self-discipline, soon made her serviceable, so that the student of psychical research was in her debt before she contributed to the building up of the "Dictionary of National Biography".

University College was so near Bertha Porter's home that the eager student was quick to catch the scent of a new trail there, and before long she was swept in, this time finally, to furnish the Egyptological *atelier* with a labour-saving appliance. Erman in Germany and Griffith in England, aware that for continuity of study the student of their day greatly needed a survey of past research, had perceived Miss Porter's qualifications for bibliographical work. A brief visit to the University of Göttingen had provided her at least with valuable contacts.

After five and twenty years of exact and patient research, Miss Porter had almost brought her labours to the point of publication when it became plain that further progress lay where she would no longer feel at ease. Other women were enlisted to aid her (1924), and gradually replaced her failing energy. But so solidly and accurately had the foundations been laid that the six volumes now published (out of eight or nine) are confessedly almost above criticism. "Porter and Moss" (or, to give the work its proper title, "Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs, and Paintings") is now a household word in Egyptology.

Ten years in bed, after so many at the desk, were cheerfully met with the same patience and old-fashioned humour. Through life Miss Porter had kept to a quaint Victorian dress, as if in quiet assurance that that era needed no apology.

NEWS AND VIEWS

President Roosevelt and Aid to the Democracies

PRESIDENT'S ROOSEVELT's speech at the dinner of the White House correspondents in Washington on March 15 will rank in future ages among the most momentous events in world history. Thereby he laid down a pledge that the efforts of a great and united people should suffer no relaxation until the total victory of the democracies over the menace of the aggression and tyranny of the dictators has been won. In his review of the events of the preceding week, following on the passing into law of the Lease-and-Lend Bill, or as he now preferred to call it the Aid-for-Democracies Bill, he stressed with the utmost emphasis two elements. Of these the first was that of speed. "The urgency," he said, "is now . . . the time element is of supreme importance," and he went on to recall, what was by that time well known to his audience, how the Bill was signed by him within half an hour of being agreed upon in both Houses of Congress, and that five minutes later he had approved a mass of articles for immediate shipment, of which, he added, many were already on their way. The second element upon which he dwelt with if anything even stronger emphasis was the comprehensive nature of the help for which democracies—among whom he went on explicitly to include China—may look to the United States, whence will come munitions in any and every form, planes, guns, tanks, ammunition, food, and the ships to carry them.

With a generosity without parallel in history, the total resources of the United States are placed at the service of those who are engaged in the struggle on behalf of free institutions; and the United States now is, in the fullest sense of the phrase, the arsenal of the democracies. Mr. Roosevelt called upon every grade of the people of the United States for great sacrifices in the interests of those in the fighting line; but he made this demand upon the national will to sacrifice and to work with confidence. For, as he had already pointed out, the decision had been fully argued by every means of popular debate, and the decisions of democracy when made were proclaimed not with the voice of any one man, but as the voice of one hundred and thirty millions. For every one of these millions the President said, the "ultimate stakes" are what he had already marked on a previous occasion as the four freedoms—freedom of speech and expression, freedom to worship God in his own way, freedom from wrong and freedom from fear.

This Presidential speech repays careful study. It is close packed with virile and telling phases, which owe nothing to rhetorical ornament. They have strengthened the enthusiasm of the people of the United States, and enheartened everywhere those who are engaged in the life and death struggle for the continued existence of democracy. Yet even the urgent and vital necessities of the immediate conflict must not be allowed to obscure the supreme significance of the President's pledge that "when the dictatorships disintegrate, . . . then our country must continue to play its great part in the period of world reconstruction for the good of humanity". Mr. Churchill, in acknowledging with gratitude in in the House of Commons the passage into law of the Aid-for-Democracies Bill, spoke of it as a Magna Charta for free nations.

It would indeed be rash to attempt to forecast even in part the implications of the close co-operation which this far-reaching measure will demand for its fullest implementation; but that Mr. Churchill's analogy is no rhetorical compliment, but rather an inspired vision of its potential force, is endorsed by Mr. Roosevelt's recital of the creed to which it will be his endeavour that reconstruction shall conform. Thus it runs: that any nationality, no matter how small, has the inherent right to its own nationhood, . . . that the men and women of such nations . . . can through the processes of peace serve themselves and serve the world by protecting the common man's security, can improve the standards of healthful living and provide markets for manufacture and agriculture. Through that trend of peaceful service every nation can increase its own happiness, banish the terrors of war and abandon man's inhumanity to man". Such then is the ultimate goal to which the President looks as the justification for his own resolve and that of the people of the United States to implement to the fullest extent the Aid-for-Democracies Bill, and for which he trusts it may be said in the days to come that "our children and our children's children will rise up and call us blessed".

Science and Post-War Reconstruction

PRESIDENT ROOSEVELT's momentous pronouncement on "the great part" which the United States will play in post-war reconstruction will be received with heartfelt relief and gratitude by all who hold fast to faith in the future of democracy as an assurance of justice as between man and man and between nations in the new world order which is to come. Most of all, perhaps, is this clearly appreciated by men of science, to whom it is a fundamental conviction that the progress towards ideals of democracy —freedom of thought and action, justice and tolerance —is to be achieved only by the application of science and scientific modes of thought to the problems of securing the conditions in which alone free institutions can function freely.

This is not merely a matter of broad and far-reaching principles—principles framed, indeed, in the Christian spirit, but to which all, irrespective of creed, race or nation, will subscribe; but it involves as a practical measure the solution of a thousand and one subsidiary problems affecting the daily life of the individual and the group or nation in which he has his being, and vitally affecting the performance of his function as a free member of a free society—problems of personal and social hygiene, education, food supply and an innumerable host of others upon which scientific workers have long been engaged and which still engage their thought even amid the preoccupations of war. In the field of the relations of national groups President Roosevelt's Aid-for-Democracies Bill has already paved the way for the lines of future inquiry and research. The vast range of inquiry into the conditions of ultimate security for humanity will draw upon the resources of all sciences, and not upon the biological and social sciences only.

New President of the American Association

Dr. Irving Langmuir, who has been elected president of the American Association for the Advancement of Science, is a well-known figure in international science, and has interested himself particularly in borderline fields extending between physics and chemistry. Early work by Langmuir on the adsorption and reactions of gases at solid surfaces proved to be of fundamental importance to an understanding of many of the phenomena of colloid chemistry, heterogeneous catalysis, surface tension, and even of such an apparently unrelated subject as thermionic emission. One everyday consequence of this work was the gas-filled electric lamp. Arising out of these investigations came the conception of the orientated monolayer as the state of material at phase boundaries, a view which has led to important advances of our knowledge of the mechanism of lubrication of metal surfaces, and of the structure of oil films on liquid surfaces. In 1938 he visited Great Britain as the first American to deliver the Pilgrim Trust Lecture before the Royal Society when he gave a characteristically informative and fascinating account of his views on the structure of protein films (see Nature, December 17, 1938); and he also delivered the Faraday Lecture of the Chemical Society, when he dealt with monolayers on solids. Dr. Langmuir received the Nobel Prize for chemistry for 1932 and was elected a foreign member of the Royal Society in 1935.

Manchester Literary and Philosophical Society: Air Raid Damage

The Manchester Literary and Philosophical Society lost its historic home, library and Dalton and Joule memorials in an air raid through the spread of a fire from warehouses. In the eighteenth century, when those who could not subscribe to the articles of the Anglican Church were excluded from the universities, academies were founded in several places, that at Manchester being a specially important one. Among the intellectual leaders of the time were Dr. Thomas Percival, a medical pioneer, and Joseph Priestley; and one of the teachers employed by the academy was John Dalton. A group meeting at Dr. Percival's house founded the Literary and Philosophical Society in 1781, and it met shortly afterwards for a time in the room attached to the non-subscribing chapel in Cross Street, which has also been burnt out. A little later the Society acquired the fine Georgian house which it has now lost, and, in that house, Dalton did his scientific work. A great deal of his apparatus and many of his notes had been placed in the basement to diminish risks, but the fury of the fire destroyed nearly everything. Dalton's watch, Joule's chronometer, some of Dalton's notes and a few small pieces of apparatus have been found and salved.

The Society has also lost, at least for a time, an income it has long received from a trust established on its behalf. In spite of these misfortunes of war, it is maintaining its activities and is asking the cultural societies of Manchester to take part in a co-operative effort for a common home worthy of the long tradition of scientific leadership associated with the names of Dalton, Joule and many later workers belonging to what is believed to be the next oldest learned society in England after the Royal Society.

The Science Museum: Air Raid Damage

The Science Museum has suffered damage by bombs during air raids on London. A number of bombs have fallen in the vicinity of the Museum, and although the building has suffered from the loss of windows, little damage has resulted to the collections. In one attack practically all the windows on one side of the building were broken, as well as many of the roof lights. Fortunately, the damage sustained by the Museum collections is slight, although a number of exhibition cases in certain galleries have been damaged by blast. Although the Museum is closed to the public, the Science Library continues to remain open, and to afford the usual facilities to readers and borrowers.

The Respirator in an Emergency

The Prime Minister and the Lord Privy Seal have both recently referred to the possible use of poison gas by the enemy. Although expressly forbidden at the Geneva Convention signed by all the powers, there are indications that make it highly desirable that the people at large shall take heed of the possibility, and review their individual and personal protection against this most horrible form of attack. Everybody has been provided by the State with an efficient gas mask or respirator; it is a simple matter to see that it is in good order and is instantly available at all times. It is not enough, however, to carry the respirator; the owner should practise frequently taking it out of the case and putting it on, holding his breath in the meantime so that the operation becomes a matter of routine which can be done in a few seconds. The respirator should be worn for periods up to twenty minutes, so that one's behaviour in it becomes perfectly normal and the original nervous feeling is forgotten.

Only after such practice does the respirator become part of oneself, and its wearing a matter of instinct in an emergency. If a person is so unfortunate as to be near a bomb containing a lethal non-persistent gas when it falls, his death or survival is a question of how few seconds it takes to put on the mask. The cloud of gas is very deadly for some hundreds of yards down a street in the direction of the wind, the length of the most dangerous zone being greatest in narrow streets. Further, everyone should have a clearly thought-out plan in their minds what they are going to do should they encounter gas; this will have to be varied according to circumstances. For example, if they are splashed with a few drops of liquid blister gas the time available to prevent a bad burn is short—a matter of five minutes. A clear plan to enter the first house, drop clothing on the doorstep and wash vigorously with soap and warm water, will prevent them becoming a casualty.

The respirator as a filter of poisoned air depends on the outstanding property of suitably activated charcoal to absorb organic vapours: the charcoal is supplemented by a pad able to hold back the finest particles of dispersed substances. The respirator is the result of prolonged study by experts, aided by the leading men of science. It is an all-purposes defensive weapon as nearly perfect as anything which is mass-produced in such enormous numbers can be. It is carefully tested in the course of manufacture, and is considered to give full protection against any war gases in the concentrations in which they are likely to be encountered by a civilian. It is not exhausted by a single encounter with gas, but should continue effective for many months. It may well be that when a respirator is put on in gas, and however quickly, it will enclose a little of the gas, which will cause irritation during the first minute or so. The impulse to tear off the mask must be resisted; also the thought that the mask is not fitting or the filter is letting gas pass. Previous practice will have proved this thought to be wrong, and very soon the respirator will be comfortable. We can do nothing when a high explosive bomb falls near; we can save our homes if we are quick when incendiary bombs fall on them; we can defeat a gas attack if we have trained ourselves in doing it.

Preparation of Fine Chemicals

THE Advisory Research Council of the Chemical Society, in collaboration with the Association of British Chemical Manufacturers, is putting into operation a scheme for organizing the preparation of fine chemicals in Great Britain by part-time volunteer workers in the laboratories of universities, technical colleges, and other institutions. It is essential to the scheme that compounds so prepared must be required for work of national importance and be not available commercially, and that the manufacturers of fine chemicals are themselves unable, or do not find it convenient, to meet the demands. It is intended that preparations should be carried out on a cost-price basis which would include charges for materials, gas, electricity, etc., but not for the workers' services. No profits of any kind will be permitted. Those who wish their names to be added to the list of volunteer helpers in connexion with this scheme should communicate with the General Secretary, Chemical Society, Piccadilly, London, W.1, to whom inquiries for fine chemicals falling within the scope of the scheme may also be made.

Issues and Parties in India

AN English resident in the Punjab writes taking exception to views expressed in these columns in a reference to Mr. L. S. Amery's review of the political situation in India in August last (see NATURE, 146, 255; 1940). He points out that while it is true that there are differences among the Indians themselves, all parties are at one in desiring Home Rule. To attain Home Rule is, or is supposed to be, the purpose of the Indian National Congress; and the preponderancy of the Hindu community in it merely reflects the fact that Hindus are a large majority in the country. It is stated that Moslems are by no means all anti-Nationalist or anti-Congress, and in fact only one party of them is so—the Moslem League, a reactionary conservative body composed of big landlords, title-holders and the like. Indeed, he adds, if a straight vote could be taken without confusing the issue by an appeal to communal fanaticism through such cries as "religion in danger", it is very doubtful if the Moslem League would have a majority over the combined votes of progressive Moslem parties. It was in fact decisively defeated in the last elections in the four provinces which have Moslem majorities. As for the Princes, they are, he says, a relic of feudalism, and do not represent their people. Although Mr. Amery's last offer, having regard to the conditions, was not so bad, it encouraged minorities to believe that however fantastic their claims, the British Government would support them, or at least allow them to hold up Home Rule indefinitely, thus lending colour to the Indian view that Britain does not really mean to give up her power and is playing the game of "divide and rule".

While it is desirable to place on record such a view of the facts of the situation in India in the interest of clearer understanding, it by no means must be held to imply assent among a people with whom religious belief and ritual is all-powerful as in India. The admission that successful opposition to the National Moslem League would depend upon the absence of an appeal to communal fanaticism, demands disruption of the social and religious functions of the individual member of a community in everyday life which is opposed to the whole of Indian culture and tradition. No doubt in many of the more progressive among the people of India, this tradition has become weaker, but nevertheless even among them it persists in some degree. It is for this among other reasons that competent observers have doubted the wisdom or even the possibility of applying the democratic ideal to Indian conditions. On this account, and not with the view of delaying Home Rule by fomenting intercommunal differences, the British Government has sought to accustom Indian ways of thought to respect for the rights of the individual through a compromise which, for the time being, appears to lay undue stress upon the claims of minorities.

Humus and the Farmer

UNDER this title, Mr. G. V. Jacks, deputy-director of the Imperial Bureau of Soil Science, Rothamsted, delivered a lecture on February 12 to the Royal Society of Arts, in which he dealt with the origin of humus, its functions in the soil, and how far shortage of humus-producing organic manures can be made good by other means. Humus is derived from decaying plant and animal residues; it acts by promoting a granular structure in the soil, by supplying energy to micro-organisms, and by providing plant nutrients. In the natural state, vegetation supplies the kind of humus in which it best thrives, but cultivated crops do not supply such an optimum product, so that human intelligence and skill are needed to bring about that biological balance in the soil which is the essence of fertility. A grass cover is especially valuable for producing the granular soil structure that is needed by our basic crops, for these are also grasses, perennial for animal and annuals (cereals) for human consumption.

When a soil has lost its virginal fertility by long-continued arable husbandry, it is best rejuvenated by laying it down to grass for a shorter or longer period. When our ancestors first enclosed the open fields, they nearly always put them down to pasture. Later, when clovers and roots were introduced, mixed farming became possible, animals could be kept throughout the winter and their manure conserved for the land. To-day much stress is laid on the necessity for rejuvenating our cultivated soils by ley farming or alternate husbandry. But the use of grass and plant and animal residues does not suffice in the absence of human skill and intelligence. These attributes became manifest when drilling was first substituted for broadcasting seed, when the art of drainage was developed, and when artificial fertilizers were invented. Such fertilizers can provide all the nutrients plants require, though they cannot produce the granular soil structure effected by humus. Plant humus, on the other hand, will not make a soil fit for permanent agriculture, for a human society makes far greater demands on the soil than does any natural plant community; nevertheless, every scrap of waste organic matter which the land produces should be returned to it.

Soviet Agriculture

IT is stated by "Russia Today" Press Service that the average annual grain crop in the U.S.S.R. for 1937, 1938 and 1939, notwithstanding the severe droughts in the two latter years, amounted to more than 100 million tons, exceeding the 1913 harvest, the best in pre-revolutionary Russia, by one third. The grain crop of 1940 amounted approximately to 112½ million tons. There are 243,000 collective farms in the Soviet Union, embracing 18,800,000 peasant households, or 94 per cent of the total number of peasant households in the country. The Soviet Government has handed over to the collective farms for their free use in perpetuity 940 million acres of land, which represents an average of 50 acres per household. It is estimated that Soviet agriculture employs more than half a million tractors, nearly 170,000 harvester-combines and 200,000 lorries.

Swahili Plant Names

THE demand for Mr. Greenway's modest little "Dictionary of Swahili-Botanical-English Plant Names", having been greater than was expected, has caused the author to prepare a second edition which is nearly three times as thick (Pp. 308+10 plates. Dar es Salaam: Government Printer, 1940. 4*s*.). The format is the same, but there have now been added a separate list of botanical and common English names, a large number of Swahili names, and ten pages of diagrams to illustrate the short glossary of botanical terms. We have noted a few trifling misprints: 'Afromomum' for 'Aframomum', 'tripinnate' for 'bipinnate' (diagram), and 'capitula' for 'capitulum', the drawing for which might equally well serve as a model for an improved garden rake. The printing is excellent, and the author is to be congratulated on providing this enlarged edition of a very useful little book for those in East Africa with little knowledge of botany.

Seventh International Congress of Genetics

THE Proceedings of the Seventh International Congress of Genetics, which was being held in Edinburgh just prior to the outbreak of war, have been issued as a supplementary volume to the *Journal of Genetics*. The difficulties in holding the Congress and the magnificent manner in which the secretariat overcame many of them has already been commented upon in NATURE. The papers, covering a varied and wide field, are published either in entirety or in summary form, under an alphabetical arrangement of author's names. A subject index to these 331 papers increases the value of these Proceedings for those who desire to know recent thought and work in genetics. The production of such a publication, in present circumstances, deserves particular praise, since the authors of some of the papers had to leave the Congress in a hurry and are now out of reach.

Control of Soil-borne Tomato Diseases

PARTIAL sterilization of the soil by heat is one of the most potent methods of control of soil-borne diseases. Amateur growers, however, do not always possess the requisite apparatus, and various chemical treatments have been suggested. Formalin is the most readily available of these, but the liquid has certain disadvantages in practice. W. Brown has briefly reported (*Gard. Chron.*, February 8) good results with an American suggestion to use formalin adsorbed upon an inert carrier such as diatomaceous earth or sawdust. The experiments relate particularly to the damping-off disease of tomatoes caused by Phytophthora fungi, and in some cases a total control of the malady was effected by the use of formalin powder applied to the seed bed when the seed was sown. Such treatment appears to provide a sustained control of damping-off, and not merely to postpone it for a time.

University of London

THE period for which Mr. H. L. Eason was appointed as principal of the University of London terminates on September 30, and the Senate has decided that the post shall not for the present be re-filled. Mr. Eason has held the office of principal since July 1937, having been a member of the Senate from 1911 and vice-chancellor from 1935. The Senate, with the concurrence of the Court, has appointed Mr. Harold Claughton as acting principal as from October 1. Mr. Claughton has been clerk of the Court of the University since the institution of the Court in 1929, and has acted as deputy to the Principal since June 1940. From 1924 until 1929 he was financial officer and secretary to the Senate.

Under an emergency statute made by the Senate, no elections by Convocation of persons to be members of the Senate will be held in the year 1941, and those persons who are due to retire on the second Tuesday in May of this year will continue to be members of the Senate until the second Tuesday in May 1942. Under another emergency statute no elections to the offices of chairman of Convocation and deputy chairman of Convocation are to be conducted before March 1, 1942, and the present holders of these offices will continue in office until the tenth day of May 1942.

DR. J. H. Gray has been appointed, as from May 1, to the University chair of anatomy tenable at St. Mary's Hospital Medical School. Since 1937 he has been senior demonstrator in anatomy at University College.

The following titles have been conferred in respect of posts held at the College indicated: professor in dental surgery on Dr. E. C. Sprawson (London Hospital Medical College); reader in mathematics on Dr. Theodor Esterman (University College) and on Mr. A. C. Stevenson (University College).

The Worshipful Company of Clothworkers has established a fellowship for graduates in science in the University. The fellowship is to be known as the "William Gilles Fellowship in Science" and will be open to internal or external graduates of the University. The award will be made biennially and will be of the value of about £220.

The degree of D.Sc. has been conferred on: Mr. P. A. I. Gorer, of Guy's Hospital Medical School; Mr. D. W. W. Henderson, of the Lister Institute of Preventive Medicine; and Mr. R. W. Haines, of St. Thomas's Hospital Medical School.

University of St. Andrews

THE "University of St. Andrews: Handbook of the United College" published by the St. Andrews University Press is a neat little brochure clad in the scarlet of the well-known gown. The University stands first in Scotland in age, and the latest of its senior foundations, the College of St. Mary, is of 1537. That of 1450 is still represented by the tower of St. Salvator. conspicuous from the sea. The unique graduate rolls date from 1413. Quaint customs survive such as Kate Kennedy Day. There was a period of decay which Johnson saw; but the College revived to produce its full share of eminent men and a reputation for research in chemistry. The successful rigour of the past is shown by a student who entered in 1819 and lived for more than six months on little more than £14. Games were prohibited in the monastic College of St. Leonard except a weekly visit to the links in the company of a Master. "It takes a heid to play golf," as a famous exponent of it once remarked. Considerable use has been made of the book on "Historic St. Andrews and Its University" by Prof. J. Read, professor of chemistry there, while Mr. John Hinton Read has provided most of the photographs for the effective illustrations.

Announcements

PROF. J. B. CONANT, president of Harvard University, who is visiting Great Britain to discuss scientific collaboration with the United States, has had conferred on him the honorary degree of doctor of science of the University of Oxford.

PROF. EDWARD A. DOISY, professor of biochemistry in the School of Medicine of St. Louis University, has been awarded the Willard Gibbs Medal for 1941. This medal, one of the highest distinctions in chemical science, is given annually by the Chicago Section of the American Chemical Society. Dr. Doisy accomplished the isolation of vitamin K from dried alfalfa leaf meal and putrefied sardine meal in 1939. Before that he had, in 1929, isolated theelin, female sex hormone and, in 1936, dihydrotheelin, another sex hormone.

DR. DIRK BROUWER, associate professor of astronomy at Yale, has been promoted to a full professorship, and has been appointed director of the Yale University Observatory in succession to Dr. Frank Schlesinger, who retires in June next.

THE supply of radium amounting to 6 gm. of the Paris Curie Institute, which had been sent into the country before the entrance of the Germans, has now been returned to Paris.

AN Institute for Tropical and Subtropical Diseases has been opened at Modena under the direction of Prof. Giovanno Serra, formerly director of the hospitals at Albertville in the Belgian Congo.

THE National Book Council, 3 Henrietta Street, London, W.C.2, is sending out lists of books specially selected for use in factories and workshops. The first issue consists of two lists in a portfolio; these lists will be supplemented at regular intervals. The titles, publishers and prices of books are mentioned, and a brief note on each entry indicates its scope. The lists are being sent free of charge to some 5,000 engineering firms in Great Britain.

ERRATUM. The title of the book by Prof. M. G. Mellon reviewed in NATURE of March 15, p. 310, was incorrectly printed as "Chemical Productions"; the book, which is published by the McGraw-Hill Book Co., Inc., is entitled "Chemical Publications".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

An Interesting Sidelight on the Causes of Coloration in Butterflies

IMMS[1] states that "pigment very commonly co-exists with structures that are, in themselves, colour producing" and that "combination colours are much more prevalent among insects than colours solely due to structural features . . . Iridescent colours are very often devoid of the presence of all pigment excepting black or dark brown . . . as a rule a background of this nature is necessary to the production of the brilliant and intense structural blues. . . ."

Butterflies of the Oriental genus Euplœa well exemplify this phenomenon, often more strongly in the male sex, and a specimen of *E. tulliolus aristotelis* Moore from British North Borneo in the Oxford University Museum throws interesting light upon it.

The butterfly, a very fine fresh male, had been seized and released by a bird, and the nip of the beak has left a conspicuous ∧-shaped 'beak-mark' on the right fore wing extending from the hinder angle forward, near to the outer margin, to beyond vein 4; it is, of course, clearly shown on the under surface also. Such 'beak-marks' have long been a subject of special study at Oxford[2], where a large collection of specimens has been gathered together, but the interest of the one in question is that it illustrates Mason's remarks on these blue reflections[3]. He examined species of butterflies with blue-green bars, etc., and found that "the remainder of the surface is dull brown except in certain positions, when it is purple to blue-green, so that as the wing is inclined this colour flashes out. The scales in these brown to blue areas are not particularly convex [as they are in the blue-green areas] but are markedly inclined to the surface of the wing, so that the tip is higher than the base and the scale makes an angle of thirty degrees with the plane of the wing. The reflection from these scales is specular, and they therefore appear bright only when the angle of incidence of the illuminating beam and the angle of reflection along the line of vision are equal.

"The two factors render the reflection colour visible when one looks along the grain of the wing, but against the grain there is no reflection and the effect is that of the brown pigmentation. . . ."

I have not been able to find a reference to Euplœa in this connexion, but the specimen under consideration shows the same phenomena; the whole wing is brown (or purple) except for small submarginal white spots. But the linear imprint of the bird's beak has acquired a colour different from that of the rest of the wing, being more blue than purple and not disappearing when the wing is tilted.

The microscope shows, first, that the pressure of the beak has ruptured the saccular scales so that the pigmented, brown, contents have escaped and dried in minutely granular masses. These, especially noticeable at the apex of the beak-mark, reflect strongly deep blue rather than purple.

Secondly, scales have been (*a*) displaced, (*b*) flattened along the line of the beak's contact, and being in different positions from the normal, tilted, scales, their striated surfaces reflect differently, so that the mark for this reason shows purple when the rest of the wing does not.

I am indebted to my friend Mr. E. B. Ford for help in the elucidation of this interesting result.

G. D. HALE CARPENTER.

Department of Entomology,
University Museum,
Oxford. Feb. 20.

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[1] Imms, A. D., "Recent Advances in Entomology" (2nd ed.), p. 194 (London, 1937).

[2] Carpenter, G. D. Hale, "Further Evidence that Birds Do Attack and Eat Butterflies", *Proc. Zool. Soc. Lond.*, A, 223–247, Plates 1 and 2 (1937).

[3] Mason, C. W., *J. Phys. Chem.*, 30, 392-3 (1926).

Effect of Temperature on the Mutation Rate of an Unstable Gene in *Portulaca grandiflora*

THERE are few data on the relation between temperature and natural mutation rate, though obviously this is important in formulating any concept of the nature of genes. Delbrück *et al.*[1] have examined the consequences of regarding mutations as simple chemical changes in molecules, and have pointed out that if the 'life' of an allele be of the order of months or years, then the mutation rate may be expected to have a Q_{10} of the order of 5. Experiments by a number of workers (reviewed by Stubbe[2]) do in fact show a high Q_{10} of that order, for genes having 'normal' mutation rates (1 in 10,000 or more life-cycles) and particularly for the collective class of lethal mutations in the *X*-chromosome of *Drosophila melanogaster*.

A frequently mutating gene on the other hand, the miniature-3-gamma in *Drosophila virilis*, has been shown by Demerec[3] to be apparently but little affected by temperature differences, and Rhoades reported at the Seventh International Congress of Genetics[4] an apparent decrease in mutations of the gene *dt* (in conjunction with another factor) in *Zea Mays* with higher temperature. On the view proposed by Delbrück, even unstable genes like these should have a Q_{10} of not much less than 4, a value which it seems impossible to reconcile with Demerec's data, after making the fullest allowance for experimental inaccuracies.

We have carried out an experiment with a mutable gene which produces coloured spots on the petals and stems of *Portulaca grandiflora* (Ikeno[5]). Four clones were grown, and one representative of each was kept in a thermostatic chamber for six weeks.

The temperatures used were 25°, 30°, 35° and 40° C. The number of mutations was estimated by taking four shoots about 10 cm. long from each plant and observing the number of spots and their size. The results are given in Table 1, in the form of the number of mutations per cm. length of stem, of 2 mm. diameter. A correction was made for large spots, since in the coloured areas no more mutations occur. (One clone produced few mutations in the stem epidermis and is excluded from the table.) Altogether 630 mutations were counted.

TABLE 1.

Clone	25°	30°	35°	40°
1	2·89	2·05	1·07	0·54
2	2·92	2·39	1·09	0·60
3	2·75	2·22	0·86	—

There is a consistent, and statistically very significant, apparent reduction in mutation rate with increasing temperature.

It is of interest to consider mutation rate not as a function of time, as is done in Table 1, but of the number of cell divisions. The areas of epidermal cells were measured, and it was found that cell size increased with temperature throughout the range tested, though maximum stem elongation took place at 35°. In Table 2, values from Table 1 have been multiplied by corresponding cell areas; they are also adjusted by a common factor making the means of the two tables equal, for easier comparison.

TABLE 2.

Clone	25°	30°	35°	40°
1	1·70	1·98	1·25	0·96
2	2·42	2·14	1·28	0·71
3	3·45	2·59	0·90	—

These values are proportional to the mutation rate per cell; an analysis of variance of the data on which they are based shows that the effect of higher temperature in reducing mutation rate is still highly significant. Moreover, petals spots, including those from clone 4, though difficult to analyse quantitatively, show the same effect.

At this stage we can offer no explanation for this rather paradoxical result. It is very desirable to know how general it is among mutable genes.

As an example of the kind of complication which is met with in studying the effect of temperature, we wish to place on record that, in Portulaca, higher temperature produces less acid cell sap, as is the case with certain Crassulaceæ. It is conceivable that pH influences mutation rate, and temperature effect might thus be indirect; altered acidity is likely to be but one of many physiological conditions changed by temperature.

We hope it may be possible to describe these experiments fully later.

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London, W.C.1.

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[1] Timoféeff-Ressovsky, N. W., Zimmer, K. G., and Delbrück, M., *Nach. Wiss. Göttingen N.F.*, 1–13, 189 (1935).

[2] Stubbe, H., "Genmutation", "Hdb. d. Vererbungswissenschaft" II.F. (Berlin: Springer, 1938).

[3] Demerec, M., *Proc. Nat. Acad. Sci.*, 18, 430 (1932).

[4] Rhoades, M. M., *Proc. 7th Inst. Cong. Genet.*, 247 (1941).

[5] Ikeno, *Jap. J. Bot.*, 4, 190 (1928).

Determination of pH in Wood

IN the course of certain researches in progress at this Laboratory it became necessary to find a satisfactory method of determining potentiometrically the pH of the moisture present in wood when the latter is in the air-dry condition, that is, at a moisture content of between approximately 5 and 20 per cent. Most pH determinations in the study of wood are applied to aqueous extracts prepared under standard conditions, and whilst the results so obtained are of value for some purposes, we have found that it is only when a wood exerts a relatively strong buffering action that an extract prepared, for example, by leaching 1 gm. of the powdered substance with 20 ml. of distilled water, can have a pH approaching closely in numerical value to that of the moisture of condition present in the wood substance prior to extraction.

Species	Moisture content at 60 per cent R.H. (% oven-dry weight)	*Mp*H
Mugongo *Ricinodendron rautenenii* Schinz.	8·14	6·69
Balsa *Ochroma* sp.	6·81	5·54
Beech *Fagus sylvatica* L.	8·93	5·21
Birch *Betula lutea* Michaux	9·65	4·62
Teak heartwood (*Tectona grandis* L.)	7·55	4·50
Oak sapwood *Quercus* sp.	11·11	4·40
Scots pine *Pinus sylvestris* L.	6·21	4·27
Sitka spruce *Picea sitchensis* Carr	10·25	3·98
Douglas fir *Pseudotsuga taxifolia* Brit. Sample (1)	8·70	3·67
Oak heartwood *Quercus* sp. Sample (1)	11·73	3·50
Oak heartwood *Quercus* sp. Sample (2)	10·86	3·16
Douglas fir *Pseudotsuga taxifolia* Brit. Sample (2)	9·77	2·89
Western red cedar *Thuja plicata* D. Don	8·27	2·46

It has been found by one of us (S. A. B.), however, that the pH of the water used to extract a sample of wood flour can be so adjusted beforehand that it undergoes no change when mixed in any proportions with the wood substance at room temperature. Thus, in short, the pH of the moisture of condition of the wood, which we propose to term the 'moisture pH', or simply '*Mp*H', is numerically equal to that of the solution containing free hydrogen ions which, when added to it under the conditions stated, undergoes neither a net loss nor gain of hydrogen ions. *Mp*H values, determined by means of the glass electrode, of samples of a number of wood species are given in the accompanying table.

It is hoped that full details about this new determination and some of its possible applications will be published elsewhere in the near future.

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True Surface Densities of Protein Films

It has been disputed[1] whether Gorter's[2] method of spreading proteins to form surface films can really give a homogeneous film unless either (*a*) very dilute solutions are used for spreading, or (*b*) very long times, from 1 to 24 hours, are allowed before the force-area measurements are made. In the case of gliadin films, however, a vindication of the earlier method has been published[3] and it appears from the figures quoted here that equilibrium is achieved within a very few minutes after the film is spread.

Further measurements suggest, however, that although, as Jenkins and Taylor show, the surface-density figures for longer times are lower because of contamination of the surface, there is some merit in performing these measurements. The figures in the accompanying table which have been obtained for zein, show that the initial drop in surface density with time is much more rapid than the later fall, but not sufficiently rapid to avoid some contamination.

Table 1.

Time (mins.)	5	5	5	10	10	30	30	60	150	290	420	1400
$d \times 10^7$	1·32	1·40	1·35	1·31	1·33	1·26	1·32	1·19	1·16	1·10	1·07	0·89
Mean d	1·36			1·32		1·29						

It is clear that the surface density of the completely spread, but uncontaminated film, is obtained by extrapolating the shallow part of the curve to zero time, when a value of $1 \cdot 21 \times 10^{-7}$ is obtained for d. A somewhat similar curve is obtained, though with less regularity, for gliadin from the averaged figures of Jenkins and Taylor.

Measurements on hen's egg albumen show a similar trend. The spreading here seems to be considerably slower, and at least half an hour is required for complete spreading. The protein films are fully reversible and can be recompressed an indefinite number of times, without alteration in the shape of the compression curves. The figures for four different spreadings are:

Table 2.

Time (mins.)	10	15	45	60	80	90	180	Extrap. density
(1)		1·20		1·10		1·06		1·13
(2)	1·37		1·19			1·13	1·10	1·165
(3)	1·13		1·09			1·06		1·125
(4)	1·14		1·07		1·02			1·13

The extrapolated densities almost entirely smooth out the fairly wide variations between individual measurements at short spreading times, and the mean value of 1·14 is closely similar to results obtained in the same way for gliadin and zein.

All the measurements were made on a substrate of $0 \cdot 01N$ sulphuric acid at room temperature.

There seems to be little doubt that this compromise between the methods of Mitchell and Jenkins and Taylor is the most satisfactory means of overcoming irregularities due to accidents of contamination and initially uneven spreading of the protein film.

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Feb. 26.

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[1] Mitchell, *Trans. Faraday Soc.*, 33, 1129 (1937).

[2] Gorter *et al.*, *Proc. Acad. Sci. Amst.*, 89, 371 (1925) *et seq.*

[3] Jenkins and Taylor, Nature, 142, 291 (1938).

Diffuse Reflexion of X-Rays

Prof. G. E. M. Jauncey[1] derives the formula:

$$\varphi_{mB} - 2\theta_B = 2(i - i_B)\sin^2\theta_B. \qquad (1)$$

for the relative position of a Bragg reflexion and the so-called "modified reflexion". The symbols are defined as follows: i is the glancing angle of incidence on the crystal plane for which $\theta_B = i_B$ is the Bragg angle: φ_{mB} is the angle between the incident ray and the direction of scattering of the modified reflexion: $i - i_B$ is supposed to be small. The disposition of the incident ray I, the scattered ray S, and the crystal plane are shown in Fig. 1. Prof. Jauncey deduces (1) from a formula of Sir William Bragg's, and it is obtained from quite different assumptions by Raman and Nath and by Zachariasen. In fact (1) is only an approximation to a formula due to Faxén which may be put in the form:

$$d \sin \varphi = \lambda \cos (\varphi - i), \qquad (2)$$

where d is the spacing of the plane for which the Bragg angle is θ: $\varphi (= \varphi_{mB})$ and i are as shown in Fig. 1. Using Bragg's Law to eliminate d and λ from (2),

$$\sin \varphi = 2 \cos (\varphi - i) \sin\theta. \qquad (3)$$

That (3) is an exact form of (1) may be proved by varying i and φ for constant θ, giving

$$\cos \varphi \, \delta\varphi = -2 \sin\theta \sin (\varphi - i).(\delta\varphi - \delta i). \qquad (4)$$

When the angle of incidence changes from θ to i, $\delta i = i - \theta$, and at the same time the angle of scattering changes from 2θ to φ, so that $\delta\varphi = \varphi - 2\theta$: if i is nearly equal to θ, $\varphi = 2\theta$ and $\varphi - i = \theta$ approximately, so that (4) gives

$$\cos \varphi.(\varphi - 2\theta) = -2\sin^2\theta. \quad (\varphi - 2\theta - i + \theta)$$
$$\text{or } \varphi - 2\theta = 2\,(i - \theta) \sin^2\theta, \qquad (5)$$

which is identical with (1) when the suffixes are introduced.

The geometrical significance of Faxén's formula (2) is shown in Fig. 2. Here O is the origin of reciprocal space, B the Bragg spot, and P the modified reflexion. Faxén's formula states that P lies in the line joining B to C, the centre of the sphere of reflexion. The angles i and φ are shown on the diagram, CN being normal to OB. The formula follows at once from the geometry of the triangle OCB.

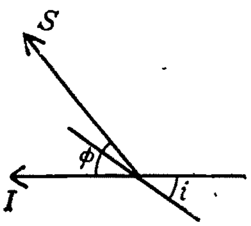

Fig. 1.

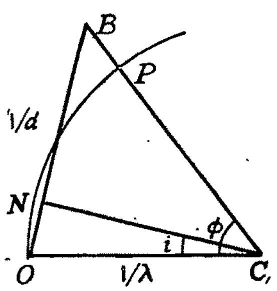

Fig. 2.

The physical interpretation of Faxén's formula is that the surfaces of constant intensity surrounding the Bragg points are spheres: I have found that the pattern given by aluminium[2] conforms to this rule, but at the time had not observed that this amounted to a verification of Faxén's formula. The function used by Prof. Jauncey in arriving at (1) has the same property.

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Feb. 26.

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[1] Nature, **147**, 146 (1941).

[2] *Proc. Roy. Soc.*, A, **172**, 116 (1939).

Influence of Œstrogens and Androgens on Glycogen Storage in the Fasting Rat

Janes and Nelson[1] have observed that glycogen storage in rats treated daily with diethyl-stilbœstrol for five days or more is at an abnormally high level. We have investigated the influence of œstrogens and other sex hormones on glycogen storage; and also on the insulin content of the pancreas (*cf.* Griffiths and Young[2]). Data are given in Table 1, including the liver and muscle glycogen contents, after a fast of approximately 18 hr., of rats carrying subcutaneous tablets of various substances for two weeks. These results show that œstriol and œstradiol resemble diethyl-stilbœstrol in promoting glycogen storage under these conditions, although œstrone and testosterone do not. It appears that the influence of these substances on liver glycogen under such conditions is to some extent paralleled by their action in causing enlargement of the liver and an increase in pancreatic insulin; it seems possible that the latter phenomenon is secondary to the increase in glycogen storage.

Table 1.

Influence of Œstrogens and of Testosterone on the Storage of Glycogen and of Insulin in the Rat.

Substance implanted	Number of rats in group	Blood sugar mgm./100 c.c.	Liver weight gm./100 gm. body weight	Liver glycogen gm./100 gm.	Muscle glycogen gm./100 gm.	Pancreatic insulin	
						u./100 gm. body weight	Percentage increment above control
Cholesterol (control)	30	108	3·82	1·13	0·37	0·70	—
Diethyl-stilbœstrol	30	109	5·79	2·27	0·41	0·95	36
Œstriol	10	115	5·13	2·32	0·39	0·93	33
Œstradiol	10	113	4·48	1·67	0·43	1·05	50
Œstrone	20	105	4·40	0·77	0·42	0·68	nil
Testosterone	10	99	3·68	0·69	0·44	0·68	nil

Table 2.

Influence of Diethyl-stilbœstrol on Glycogen Storage in the Fasting Rat.

Treatment of rats	Amount injected	Number of rats in group	Blood sugar mgm./100 c.c.	Liver weight gm./100 gm. body weight	Liver glycogen gm./100 gm.	Muscle glycogen gm./100 gm.
Killed initially	—	30	97	2·86	0·85	0·31
Injected and fasted 30 hours . .	Nut oil only	35	95	2·87	0·57	0·31
,, ,, ,, ,, ,, ...	0·10 mgm.	20	93	2·94	1·04	0·32
,, ,, ,, ,, ,, . .	1·00 mgm.	25	99	3·01	1·96	0·34
,, ,, ,, ,, ,, . .	10·00 mgm.	20	109	3·98	2·04	0·30

When rats were fed on cellulose for 30 hours in order to deplete the glycogen stores, and were then given a single subcutaneous injection of various substances in nut-oil, an increase in liver glycogen was found to occur, in some instances, during a subsequent 30-hour fast. The results with different doses of diethyl-stilbœstrol in experiments of this type are shown in Table 2, and indicate that a single injection of 0·1 mgm. of this substance is capable of increasing the liver glycogen content of the fasting rat under such conditions. No obvious change in muscle glycogen content or in blood sugar level was observed in these experiments, with the possible exception of those in which 10 mgm. of diethyl-stilbœstrol was used. Again the increase in liver glycogen content was accompanied by an increase in liver size; it should be mentioned that the treated rats lost little, if any, more body-weight during the fasting period than did the control animals. Œstradiol and œstriol were found also to induce an increase in the liver glycogen content of the fasting rat under similar conditions, a property in which they resemble hormones of the adrenal cortex[3,4].

These experiments show that some œstrogens can exert a profound influence on carbohydrate metabolism, inducing an increase of pancreatic insulin and a positive increase, not merely diminished loss, of liver glycogen in the fasting rat, the latter being apparently not due to a transfer of glycogen from the muscles to the liver (Table 2).

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H. P. Marks.
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Feb. 20.

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[1] Janes, R. G., and Nelson, W. O., *Proc. Soc. Exp. Biol. N.Y.*, **43**, 340 (1940).

[2] Griffiths, M., and Young, F. G., Nature, **146**, 266 (1940).

[3] Britton, S. W., and Silvette, H., *Amer. J. Physiol.*, **100**, 693 (1932).

[4] Long, C. N. H., and Katzin, B., *Proc. Soc. Exp. Biol., N.Y.*, **38**, 516 (1938).

RESEARCH ITEMS

Early Cult Figures from the Indus Valley

Seals showing the figure of an unidentified deity found at Mohenjo-daro have been identified tentatively by Sir John Marshall as Śiva-Paśupati, but Saletore regards them as representations of Agni. The latter would weigh in favour of the Aryan hypothesis of Harappa cultural origins in the Indus Valley. Agni has no counterpart in the pre-Aryan cultures known to us. The argument in favour of the identification with Siva rests in part on the character of the trident-like head-dress, which Saletore maintains does not represent Siva's trident. This head-dress is regarded by A. Aiyappan (*J. R. Asiat. Soc. Bengal, Letters*, **5**, 3; 1940) as the key to the understanding of the nature of the religious representation intended by the seals on which the figures appear. Taken as a group, there can be little doubt that the sculptor intended to show two, not three, horns. Agni is shown as three or four horned, and though he is likened to various animals such as bull, steed, winged bird, or goat, nowhere is there any suggestion that he should have a pair of buffalo or bison horns. To the ethnologist the head-dress is full of interest. Its various forms find counterparts in the head-dresses of modern Indian tribes, the Bison-horn Gonds, the Koyas and Savaras of the Eastern Ghats and the Naga tribes of Assam. That of the Kalyo Kengyu warrior of the Naga Hills is almost a modern copy of that of the Mohenjo-daro figures. The meaning of the latter can only be gathered if considered from the ethnological angle, though identity of significance must not be postulated. Nevertheless, it would appear from modern instances that there are rites allocated with fertility and buffalo cults which still exist among many tribes and even Hindu castes in a vestigial and attenuated form but may well have been a living cult when the culture of Mohenjo-daro flourished. The Mohenjo-daro deity does not possess many attributes of the Siva of modern Hinduism, but his most fundamental qualities are suggestively indicated—the horns suggesting the trident and fertility, the phallic aspect and the pose and surroundings of Siva's yogic characteristics.

Studies on Reef Corals

Vol. 2, No. 1, of the Palao Tropical Biological Station, Tokyo, 1940, includes several papers on reef corals dealing with growth, biochemistry and environment. S. Motoda contributes three: "A Study of Growth Rate in the Massive Reef Coral *Goniastrea aspera* Verill", "The Environment and the Life of the Massive Coral, *Goniastrea aspera* Verrill", and "Comparison of the Conditions of Water in the Bay, Lagoon and Open Sea in Palao". K. Hosoi in his work on the biochemistry of the coral has investigated the "Occurrence of Iodine in the Polyp of *Funigia actiniformis* var. *palawensis* Döderlein, the Distribution of Nitrogen in the Protein of the Polyp, and the Amount of Calcium and Carbonate in the Skeleton". N. Abe writes on the growth of the same species and its environment. Interesting observations are made by Motoda on Goniastrea in which he finds that the actual living polyps are eaten by certain fishes. This coral when transplanted to the reef margin was much damaged by being bitten by fishes, although this did not take place in its natural habitat. The author also observed that the reef fishes in the aquarium of the Laboratory frequently pick the living polyps of the reef corals until these lose the soft bodies and are killed. Also he states that it is seen when diving that many small reef fishes are picking upon the surface of the living corals. Although, as other observers have maintained, it may be that the fishes are feeding on the algæ growing on the corals, these new observations appear to show that the fishes do eat the actual polyps. In addition to the studies on corals there is a paper on the "Oligochæta from the East and West Carolines, South Sea Islands" (I) by S. Ohfuchi, and one on the "Luminescence of the Fishes belonging to the Family Leiognathidæ of the Tropical Pacific" by Y. Haneda.

Measurement of Solar Radiation

A paper on the measurement of solar radiation for ecological work has recently appeared (Bericht über das Geobotanische Forschungsinstitut Rübel in Zürich für das Jahr 1939. Von E. Rübel und W. Lüdi. Pp. 152. Zürich: Geobotanische Forschungsinstitut Rübel, 1940). It describes a dozen different sorts of commercially produced apparatus (mostly unfamiliar to the reviewer) some intended to measure the total energy of radiation, others particular wave-lengths, and yet others the total energy over a period. The principles and limitations of each apparatus are discussed, and should enable a reader with a definite problem to choose his apparatus. The other papers deal with the changes observed in some quadrats of alpine grassland over a century, the alpine vegetation of Mt. Etna (both treated statistically), and a very brief paper on pollen analysis.

Nomenclature of Fungal Genera

Mycologists, as the custodians of nomenclature in one of the most dynamic groups of living organisms, have the duty of critical review of their taxonomic groups, as knowledge about the systematics of their subject increases. A committee of the British Mycological Society has been appointed to perform this work, and the third of its "Nomina Generica Conservanda" has recently been published under the name of E. M. Wakefield, secretary to the Committee (*Trans. Brit. Mycol. Soc.*, **24**, Pts. 3 and 4, 282–293; Dec. 1940). This deals, among other questions, with the nomenclature of Daldinia, Dothidella, Agaricus and Psalliota, Septoria and Ramularia. It is necessary that someone should work through the mass of what would be dreary detail for most workers. The recommendations of the committee are usually trenchant; only in its consideration of Agaricus versus Psalliota has it lost the determination to return from the established Psalliota to the valid Agaricus.

Intergeneric Hybrids of Saccharum

E. K. JANAKI-AMMAL (*J. Gen.*, **41**, 217–254; 1941) has described intergeneric hybrids of Saccharum with species of Narenga, Erianthus, Sorghum, Zea, Bambusa and Imperata. The variety and number of these hybrids together with their morphology and fertility provide astonishing and most valuable information regarding the possibilities of hybridization involving a high polyploid, such as is found in Saccharum. The present paper describes: (1) the cross *S. spontaneum* ($2n = 112$) with *Erianthus ravennæ* ($2n = 20 + f.$). The F_1 has 66 chromosomes and is fertile and gives rise to diploids, triploids and tetraploids. Segregation of Erianthus characters occurs among the diploids. The chromosomes of *S. spontaneum* form bivalents,by autosyndesis in the F_1, and may form trivalents with some of the chromosomes of Erianthus. The sugar content of the diploid F_1 is lower than in *S. spontaneum.* (2) The cane *POJ*2725 arose from continued crosses of *S. spontaneum* with *S. officinarum* ($2n = 80$) and has $2n = 106$. When this plant was crossed with *Imperata cylindrica*, thirty-five seedlings with fairly high sugar content were obtained. These were (*a*) vegetative seedlings and resembled the maternal parent, (*b*) selfed or parthenogenetic seedlings with 108–112 chromosomes, (*c*) triploid self seedlings ($2n = 156$), and (*d*) true hybrids ($2n = 120–134$). Seedlings from this last category segregate for Imperata characters. (3) In crosses of *S. officinarum* with *Zea Mays* ($2n = 20 + 1B$), one hybrid which survived had 52 chromosomes and remained dwarf and has not flowered. Novel characters, not present in the parents, are seen in the hybrid.

South African Geology

THE country around Potchefstroom and Klerksdorp is one of the most interesting districts of the Transvaal, including, as it does, all the principal geological formations from the Witwatersrand to the Coal Measures of the Karroo, with the exception of the Waterberg system. The area has been described in detail by L. T. Nel and others in the "Explanation of Sheet No. 61", recently published by the Geological Survey of South Africa. The extraordinarily thick Witwatersrand system was accumulated above a denuded and subsiding surface of the Older Granite, occasional pebbles of which have been found in the lower Witwatersrand grits. A second unconformity comes between the Witwatersrand and the Ventersdorp lavas and is particularly marked in the Klerksdorp area. A third break is found at the base of the Transvaal system, which was deposited on a comparatively flat surface like that of a peneplain. After the close of this period the older rocks were subjected to regional folding and erosion. Long afterwards the Coal Measures of the Karroo system were deposited. Most of these flat-lying beds have been since removed by denudation, and the underlying structure is seen to be a major syncline of Transvaal sediments with older formations arched up on both sides. The axis curves round the Vredefort dome, part of which appears in the south-eastern corner of the area mapped. As the Older Granite which occupies the central portion of the dome is older than the Witwatersrand system, it must have been raised as a solid plug through a vertical distance of thousands of feet. The origin of this unique structure, with its associated overturning of the surrounding rocks and the production of pseudotachylyte, has aroused wide discussion. Dr. Nel, however, is obliged to admit that a complete solution of the tectonic problem cannot yet be claimed. The memoir contains an important review of the magnetic anomalies in the Witwatersrand system, petrological details of the many igneous rocks of the area, and a full account of the economic products, with special reference to gold and water supplies.

Heavy Oxygen

THE fact that oxygen in air has a somewhat higher atomic weight than that in water was discovered by Dole in 1935, and the difference has since been measured by several observers. There is still some uncertainty attached to the results owing to (1) the still imperfectly known degree to which different natural waters differ in density, (2) the possibility of variation of the same source of water at different times, (3) the possibility of different isotopic separations during the purifications. The rapid and complete exchange of oxygen in many inorganic salts with the solvent water suggests that the Dole effect could be measured by this method, and some experiments with sodium dichromate have been reported by O. R. Alexander and N. F. Hall (*J. Amer. Chem. Soc.*, **62**, 3462; 1940). Exchange experiments were made with water synthesized from atmospheric oxygen and Lake Mendota water as standard. The results showed that the excess density due to air oxygen is $7{\cdot}65 \pm 0{\cdot}2\ \gamma d$ with Madison city water regarded as normal and $7{\cdot}1 \pm 0{\cdot}2\ \gamma d$ with Lake Mendota water regarded as normal. The oxygen of the dichromate was somewhat heavier than that of the lake water and much lighter than that of the air water. These experiments thus substantiate the Dole effect.

Reactions of Atoms and Free Radicals in Solution

IT appears that substitution and displacement reactions in organic chemistry fall into two groups in which the reaction proceeds by (A) an ionic or polar mechanism and (B) atomic or free radical. The photochemical (peroxide catalysed) chlorination of a hydrocarbon is a familiar example of a B-type reaction with two possible mechanisms with the chlorine atoms produced in the primary process:

$$\begin{array}{ll} (B_1) & (B_2) \\ Cl\cdot + RH = RCl + H\cdot & Cl\cdot + RH = R\cdot + HCl \\ H\cdot + Cl_2 = HCl + Cl\cdot & R\cdot + Cl_2 = RCl + Cl\cdot \end{array}$$

The substitution of chlorine for hydrogen on the asymmetric carbon atom of an optically active compound by process B_1 would result in Walden inversion with retention of optical activity, whilst the reaction according to process B_2 would yield an optically inactive *dl* product if a free radical with an appreciable half-life period is formed. H. C. Brown, M. S. Kharasch and T. H. Chao (*J. Amer. Chem. Soc.*, **62**, 3435; 1940) have investigated the photochemical chlorination of primary active amyl chloride from this point of view. Six possible isomers result from the introduction of a second chlorination, and it was necessary to isolate the 1,2-dichloro derivative and examine it for optical activity. This could be done by careful fractional distillation, and the product was found to be optically inactive, thus indicating that substitution occurred by process B_2. The other products of the reaction were also investigated, and the two isomers not previously reported were isolated.

PARALYSIS PRODUCED IN WHITE RATS BY A RACHITOGENIC DIET

By Dr. H. A. Shapiro,

Biological Control Laboratories, Union Health Department, Cape Town

DURING the course of rachitogenic experiments with white rats it was noticed that if the rats were kept for prolonged periods on Steenbock's No. 2965 diet, a progressive paralysis of the hind limbs developed.

The diet consisted of the following :

Whole yellow maize (finely ground)	76	per cent
'Energen' gluten	20	,,
Calcium carbonate	3	,,
Sodium chloride	1	,,

Young rats of either sex weighing 40–60 gm. when placed on this diet developed severe rickets in three weeks. This was obvious by swelling of the wrists and the knees, and was further demonstrated (*a*) in sections of the distal halves of the radius and the ulna stained by the usual silver nitrate method, (*b*) by X-ray studies of the bones.

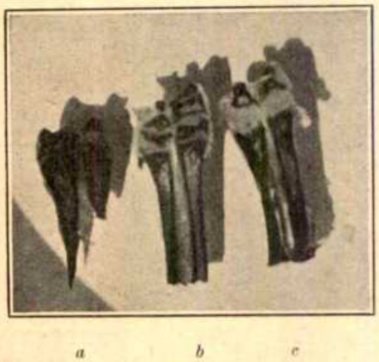


Fig. 1.

a, NORMAL BONE (RADIUS AND ULNA) ; *b*, PARTIAL HEALING ; C, SEVERE RICKETS.

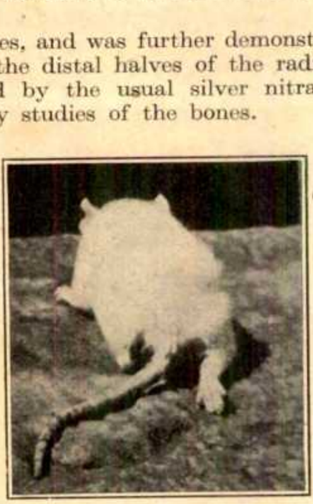
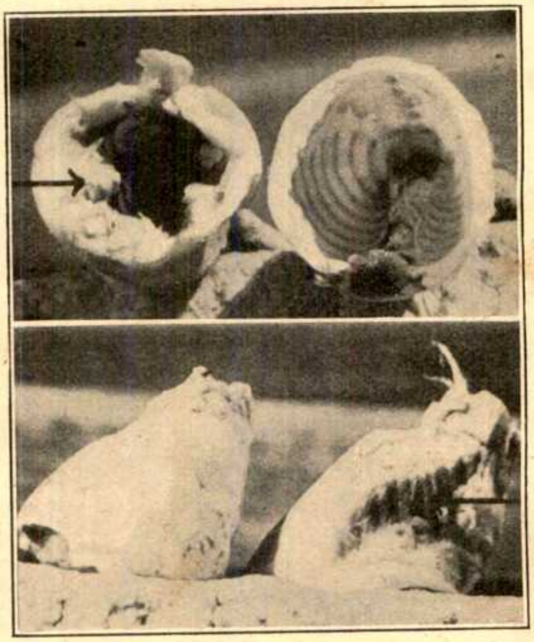


Fig. 2.

EXTENSOR WEAKNESS OF RIGHT FOOT.



INFERIOR (ABOVE) AND LATERAL (BELOW) ASPECTS OF CHEST. THE RICKETY CHEST, SHOWING COLLAPSE OF RIBS, IS ON THE LEFT ABOVE, AND ON RIGHT BELOW.

When the animals were kept for considerably longer on this diet the rickets became much worse (Fig. 1*c*) and after 6–9 weeks the earliest signs of weakness of the hind limbs developed. This consisted of a widening of the base, especially well marked in some of the animals at rest, together with a well-defined foot-drop (Fig. 2) in either or both feet due to weakness of the extensor ('antigravity') muscles and an inco-ordination of the gait. The weakness of the hind legs spread progressively until after 7–10 days the animal was unable to stand on all fours. It then progressed by pulling its hindquarters along with the aid of its forelimbs, which showed no signs of weakness in spite of the severe degree of rickets.

With the full development of the paralysis other signs of a cord lesion appeared, namely, urinary incontinence and a persistent priapism.

The paralysis was not flaccid although there was considerable wasting of the thigh muscles, especially of the extensors. Definite tone was maintained in the flexors (hamstrings) and in the tail. Such animals showed maximal rachitic signs ; for example, the development of a marked degree of 'pigeon chest' due to the falling in of the ribs (Figs. 3 and 4). In all, a total of eight animals was placed on this diet in the course of five months. All eight animals developed this paralysis.

Autopsy of three of the animals failed to reveal any macroscopic hæmorrhages in the nervous system. The marked atrophy of all the thigh muscles, especially of the extensors, was confirmed.

There was a superabundance of carotene in the diet (yellow maize) and there was no evidence in the eyes or the teeth of any vitamin A deficiency. The colour of the teeth was, if anything, better than that of the normal control animals. This point is of importance, since Irving and Richards[1] have reported that degenerative changes are observed in the nervous system of rats on a vitamin A deficient diet. In their experiments, however, the chief changes were seen in the medulla.

At no stage in the development of the paralysis was there any evidence of a peripheral neuritis such as might be attributable to an aneurin (vitamin B_1) deficiency, namely, pain and tenderness of the affected limbs when these were palpated. Moreover, clinically the syndrome of progressive paralysis did not resemble the paralysis produced by vitamin B_4 deficiency in rats[2,3]. B_4 deficiency in rats results in the adoption of a hunched position 'walking high' on the hind-legs with a progressive loss of co-ordination[3].

It appears unlikely that vitamin C can be involved in the production of this syndrome.

α-tocopherol, whether given by mouth or by injection in the form of the acetate, at the stage when foot-drop was noticed, was unable to arrest the steady progression of the weakness.

The possibility still exists that some other component of the E complex may be involved. In view of the fact that whole maize was used it appears unlikely that the diet could have been E deficient, in spite of the fact that clinically the syndrome fairly strongly resembles the picture of vitamin E deficiency. In any event the paralysis is unlikely to be due to an α-tocopherol deficiency.

The possibility remains that the lesions may be due to marked vitamin D deficiency in one of two ways:

(1) Vitamin D may be necessary for the proper nutrition of the nervous system.

(2) Since the paralysis so far has been observed only in severely rachitic rats, the lesion may be secondary to a mechanical complication as a result of the rachitic process having affected the vertebræ, especially in the lumbar region. I am indebted to Dr. N. Sapeika for this suggestion.

It is of interest to note that Greenberg, Boelter and Knopf[4] reported observations on rats on a low calcium diet which accorded with the description of neurological lesions in rachitic rats described by Boer, Arons and van der Ryst[5]. Van der Ryst and Arons[6] also used the Steenbock No. 2965 diet, and they described paralysis and hæmorrhages in the nervous system in 75 per cent of rachitic rats on this diet. They did not conclude, however, that the symptoms were due to lack of vitamin D.

The simplicity and the purity of the diet used in the experiments recorded in this note render it unlikely that the syndrome observed is due to a poison or toxin.

It remains possible that the symptoms resulted from protracted vitamin D deficiency, or that some other vitamin is necessary for the proper nutrition of the nervous system. Although it seems most unlikely that the vitamin E complex is involved here, it should be noted how closely the paralysis described in these experiments resembles the paralysis seen in the hind limbs in vitamin E deficiency. On this rachitogenic diet the forelimbs were never affected. This is unlike vitamin E deficiency paralysis.

Further studies on the histology of the nervous system and the affected muscles, as well as of the prophylactic role of vitamin D and certain other vitamins, are in progress.

I wish to thank Prof. W. F. Rhodes for his interest in this investigation. The photographs are 'stills' taken from a moving picture record made by Mr. L. Lewis.

[1] Irving, J. T., and Richards, M. B., *J. Physiol.*, **94**, 307 (1938).

[2] Reader, V., *Biochem. J.*, **24**, 1827 (1930).

[3] Kline, O. L., Elvehjem, C. A., and Hart, E. B., *Biochem. J.*, **30**, 780 (1936).

[4] Greenberg, D. M., Boelter, M. D. D., and Knopf, B. W., *Science*, **89**, 18 (1939).

[5] Boer, J., Arons, P., and van der Ryst, M. P. J., *Arch. Neerl. Physiol.*, **22**, 594 (1937).

[6] Van der Ryst, M. P. J., and Arons, P., *Arch. Neerl. Physiol.*, **23**, 592 (1938).

FORESTRY IN BALUCHISTAN

THOSE who have visited Baluchistan, even if such a visit was confined to Quetta only, will know that most of the country, the total area of which is 126,000 square miles, of which 53,000 square miles are under British administration, is mountainous with broad upland valleys and that there is a striking lack of trees and a general absence of vegetation. Barren, sunburnt, rugged hills scored by rocky precipitous gorges, the slopes with scattered dots representing juniper or olive stunted trees, alternate with bare stony plains. Parts of this country, as is the case with the adjacent Seistan and Iran, are fertile enough once water can be brought to them. The rainfall is low, 5–15 in. (the latter in the highlands), but is not so deficient that it could not support, and did once support, a better type of vegetation. Examples are noted of forests having disappeared within the last fifty years, notably around Quetta and near the railway, around Fort Sandeman and Loralai, near Tomagh State Forest, and so forth. It is held that desert conditions are advancing from the west and that these conditions are due to the improvident and unchecked habits and actions of the population—felling, lopping, bark stripping, and excessive and continuous goat browsing, in which the nomads are probably the worst offenders. Erosion is very severe, and one stream which has been under observation is reported as carrying away as much as 450 tons of soil in an hour. Many of these facts have been known for the last three or four decades, but they have never received really serious attention by the administration, and such forest service as there has been has been negligible and of inferior status.

Attention has been directed to the present position of affairs in a "Note on a Tour of Inspection of Baluchistan" by S. H. Howard, acting inspector general of forests (Government of India Press, Simla, 1940), and the report comes none too soon if the remnant of vegetation and the forests in the highlands are to be saved from extermination.

It is a curious reflection on British administration that in so many parts of the world at the present day the similar problem of the man-made desert being brought about by the unchecked acts of the people upsetting to the ordinary laws of Nature is presenting itself to the British administrator.

Juniper (*Juniperus macropoda*, Boiss.) is one of the chief species of the country, and there are remnants of an old forest at Ziarat. The wood of this tree could, says Mr. Howard, be used for pencils, slate frames, picture frames, and so forth, for which a sale might be developed, or a local factory might pay. This presupposes that a greater protection of the forests is introduced by Government and that the Government forest area should be raised from 0.6 per cent of the country (its present extent) to something nearer 20 per cent. Other tree species are olive (*Olea ferruginea*) and khanjak (*Pistacia Khinjuk*). Of these, rough statistics appear to show that a juniper takes 40–180 years to grow one foot in girth (a 6-ft. tree is 250–1000 years old), an olive coppice shoot about 35 years to grow one foot girth, and a khanjak about 25 years. The principal minor product is Ephedra, but Artemisia, Hyoscyamus, Datura, juniper berries and perhaps Pyrethrum are other possibilities. In the highlands one of the chief species is the beautiful chilghoza or silver-barked pine (*Pinus Gerardiana*).

Of course, in so dry a country fuel becomes an important problem. There appears to have been a great development in its supply during the last few years with a corresponding high level of expedition in extraction. This scheme would be disquieting in so barren a country, and Mr. Howard makes recommendations which would certainly appear to be required, that a chief forest officer from the Imperial Forest Service should be appointed, and that the forestry question in Baluchistan should be treated as a question which has become of serious importance if the conditions of life of the population are to be improved instead of the country being permitted to fall into a state of greater desiccation and denudation.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Saturday, March 22

ROYAL PHOTOGRAPHIC SOCIETY (Scientific and Technical Group) (at 16 Princes Gate, London, S.W.7), at 3 p.m.—I. Annual General Meeting; II. "Airscrew", a 16 mm. Sound Film, illustrating Design, Manufacture, Precision, etc.; III. A Demonstration of some Captured German Cameras by a Service Officer.

Tuesday, March 25

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir James Jeans, F.R.S.: "The Physical Condition of the Planets".*

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 3 p.m.—Miss B. Blackwood: "Some Arts and Industries of New Guinea and New Britain" (Films).

Wednesday, March 26

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir Richard Gregory, Bart., F.R.S.: "Discovery and Invention" (Aldred Lecture).

Thursday, March 27

BRITISH PSYCHOLOGICAL SOCIETY (Industrial Section) (at 55 Russell Square, London, W.C.1), at 1.20 p.m.—Dr. Marie Jahoda: "Some Remarks on Incentives to Work".

Friday, March 28

ASSOCIATION OF APPLIED BIOLOGISTS and SOCIETY FOR EXPERIMENTAL BIOLOGY (Joint Meeting at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 12 noon.—Discussion on "The Relationship between Pure and Applied Biology". 12.5 p.m.—Prof. P. A. Buxton: Opening Address. 12.35 p.m.—Prof. W. B. Brierley will speak from the Botanical side. 2.15 p.m.—Dr. V. B. Wigglesworth, F.R.S.: "Malaria and War". 3 p.m.—Dr. M. A. H. Tincker: "Aspects of the Application of Growth Substances to Practice".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at the Mining Institute, Newcastle-upon-Tyne), at 6 p.m.—Mr. W. T. Bottomley: "The Economics of the Design of Condenser Plant and Cooling Water Systems, applicable to Power Stations".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

PRINCIPAL OF THE LEEDS COLLEGE OF TECHNOLOGY—The Director of Education, Education Department, Calverley Street, Leeds 1 (March 29).

TEACHER OF SPEECH TRAINING in the Aberdeen Education Committee's Schools—The Director of Education, Education Offices, Municipal Buildings, Castle Street, Aberdeen (March 29).

LECTURER IN MECHANICAL ENGINEERING SUBJECTS in the Schools of Technology, Art, and Commerce, Oxford—The Chief Education Officer, City Education Office, 77 George Street, Oxford (April 2).

HEAD OF THE MECHANICAL AND CIVIL ENGINEERING DEPARTMENT of Sunderland Technical College—The Secretary, Technical College, Sunderland (April 5).

ASSISTANT PROFESSOR IN THE DEPARTMENT OF GLASS TECHNOLOGY—The Registrar, The University, Sheffield (April 18).

UNIVERSITY LIBRARIAN—The Registrar, The University, Sheffield (April 18).

PROFESSOR OF ZOOLOGY at Bedford College for Women—The Academic Registrar, Royal Holloway College (University of London), Engefield Green, Surrey (April 21).

ASSISTANT LECTURER IN PHYSIOLOGY—The Secretary, The University, Edmund Street, Birmingham 3 (April 25).

RADIUM OFFICER—The Secretary, Radium Institute, 1 Myrtle Street, Liverpool.

ASSISTANT ENGINEER FOR THE DRAINAGE AND IRRIGATION DEPARTMENT, Malays—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M19316).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Carnegie Trust for the Universities of Scotland. Thirty-ninth Annual Report (for the Year 1939–40) submitted by the Executive Committee to the Trustees on 10th February 1941. Pp. iv+86. (Edinburgh: Carnegie Trust for the Universities of Scotland.) [122

Other Countries

Bericht über des Geobotanische Forschungsinstitut Rübel in Zürich für das Jahr 1939. Von E. Rübel und W. Lüdi. Pp. 152. (Zürich: Geobotanische Forschungsinstitut Rübel.) [102

Canada: Department of Mines and Resources, Mines and Geology Branch: Bureau of Mines. Stabilized Roads. By R. H. Picher. (No. 800.) Pp. v+41 (3 plates). (Ottawa: King's Printer.) 25 cents. [102

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SCIENTIFIC UTILIZATION OF RESOURCES AND MAN-POWER

THE Select Committee on National Expenditure has from the start taken a wide view of its functions, as an admirable series of reports testifies. Appointed to examine the current expenditure on the war services "and to report on what, if any, economies consistent with the execution of the policy decided by the Government may be effected therein", with its team of sub-committees, the Committee has constituted itself a body for keeping Government departments up to scratch in many matters which have only an indirect bearing on the war effort. None of the reports yet issued by the Committee more fairly earns the thanks of the nation than the third and fourth reports, recently published, both of which discuss questions of man-power and production. That in its third report the Select Committee should have found it necessary to recapitulate at length the experience in regard to the relation between industrial output and hours of work, is the more disquieting in view of the seriousness of the man-power situation. The warning, it will be recalled, had already been given in a report issued by the Home Office early in the War, on hours of employment of women and young persons in factories, and in a later report prepared by the British Association for Labour Legislation.

The Sub-Committee on Supply Services of the National Committee now reports in fact that the lessons which the War of 1914–18 should have taught seem largely to have been ignored in respect of overtime and hours of work. Even if the demands on man-power had not been accentuated in the present struggle, failure to profit by past experience could not but handicap our efforts. A like failure to learn the lessons of the past is implied in the fourth report of the Select Committee, on contracting. The co-ordinating sub-committee which submitted the report rightly observes that if maximum output is to be achieved the expenditure of national reserves—whether in man-power, in materials, or in capital equipment—must be at a minimum for each unit of output, and one indispensable method of bringing this about is to pay the closest attention to sound methods of contract procedure.

The prime necessity in a war economy is for the maximum and most efficient use of man-power and materials, and from the point of view of the elimination of waste this latest report is probably the most valuable of the eighteen that have so far appeared. Any contract price will contain four elements : the cost of materials, the cost of labour, overhead costs and profit, to which in main contractors' costs must often be added a fifth, payments to sub-contractors. The control of costs is, therefore, the simplest method by which to attain the maximum efficiency. The acute analysis of cost control and departmental organization, and the masterly survey of the conflict between urgency and carefulness in placing contracts, are examples of lucid thinking which should give the report an assured place in the literature of scientific management, carrying implications far beyond its immediate purpose.

The report indeed makes a distinct contribution to the scientific organization of our war effort, on the positive side as well as from the negative aspects of eliminating waste. With the details of this report only a few scientific workers, and chiefly those in administrative positions, are directly concerned. The report recommends a fixed price contract as the best type of contract. When a target is used with a maximum price contract, sufficient inducement should be given to the contractor to effect savings. Closer scrutiny should be given by departments to the costs allowed for labour on costed contracts, with the view of securing that it shall be employed in the most efficient manner, and severe comment on the time lost in doing all over again the costing and inspection work of reliable and experienced firms, and in doing it in several departments, leads to recommendations designed to avoid such waste and to stop duplication of costings by different State departments.

Great importance is attached to the fullest use being made of the capacity of small firms, and to the financing of such firms properly where necessary. The absence of co-ordination of departments is again the subject of severe strictures, although the difficulty of correcting inefficiency or economic defects is recognized. The importance of careful examination of departmental organizations to secure the maximum co-ordination in future planning, to ensure the allocation of labour to the best advantage, and of the effective tackling of the question of training and securing of potential labour, is stressed.

It is significant that the report should have to recommend that all constructional building, with the exception of fortifications and defence works, construction of aerodromes and works overseas, should in future be the responsibility of the Ministry of Works and Buildings. Similarly, the recommendation that the purchase of general stores, clothing and personal equipment should be the function of a separate new branch suggests that the work of allocating duties to the departments best fitted to receive them is not yet complete. The waste, inefficiency and lack of co-ordination brought to light, not for the first time, in this report should not be allowed to persist. It would indeed be deplorable if there were any delay in implementing the findings of this valuable and suggestive report.

As has already been indicated, the third and fourth reports have some ground in common. Looking at the matter from the point of view of economy, the fourth report points out that to meet the demand for speed by heavy overtime is not only costly, but also, as has been shown on many occasions, after a short period of application, causes a high sickness rate and other losses of effort symptomatic of industrial fatigue, and will finally result in an actual decrease in output. The third report deals with this question at greater length, three of its sections dealing with overtime, dilution and training of labour, and with the effect of overtime on costs.

Before the increased drive for production began in May last, the Sub-Committee on Supply Services was perturbed at the amount of overtime which was being worked. Excessive overtime was found to be bad for production, while if a certain amount of overtime was not worked, men left their factories for others where they could earn more by working overtime. These symptoms were intensified as a result of the two months of extreme effort following the Government's appeal after the invasion of Holland and Belgium. Absenteeism became much more common and men arrived late for their work. Sunday labour led to men taking a day off in the middle of the week, when, of course, they only lost an ordinary day's pay. When at the end of July, in the Royal Ordnance factories, where absenteeism had risen to 15 per cent, it was decided to discontinue Sunday labour wherever possible, and very often Saturday afternoon as well, time-keeping improved and production did not suffer, or even increased.

The Sub-Committee accordingly strongly recommends that hours of work should be reduced to those set out in the Ministry of Labour's July circular as soon as possible. It is also essential that any reduction should be generally applied, in order to prevent men moving from one factory to another in search of longer hours and more pay. Only so can adequate account be taken of the four general facts, established during 1914–18, but recapitulated here so firmly and clearly by the Sub-Committee: increased hours of work above an optimum which varies slightly with different industries do not increase output proportionately, and may even result in a decrease; when heavy overtime is worked for prolonged periods, the general health of workers is undermined; if overtime has been prolonged a reduction in hours will increase output, though there will be a time-lag corresponding to recuperation of energy. If general health is undermined, a reduction to optimum hours will fail to effect the required increase of output.

A major cause of industrial fatigue is eyestrain, and the report recommends full and urgent investigation of the interior lighting of factories and workshops. The requirements of the black-out make it essential that methods of lighting scientifically devised to protect the worker from eyestrain should be fully investigated. It is also recommended that the 'spotter' system of roof-watching to avoid loss of production during air-raids should be linked up with the Observer Corps; and that the removal or wiring of glass in the roofs of workshops should be expedited.

The main obstacle to the abolition of excessive overtime is the shortage of labour, especially skilled labour. The remedy for this is dilution and training, and the Sub-Committee considers that there should be a continued drive to attain the maximum dilution of labour. Once more it is urged that the compulsory powers regarding the movement of labour should, if necessary, be fearlessly used. It is particularly desirable that more training should be done in the factories themselves, in addition to the training centres set up by the Ministry of Labour. Moreover, excessive increase in costs is attributed to abnormal overtime increasing costs out of all proportion to the increase in production. The Sub-Committee records its opinion that this situation, in view of experience during 1914–18, should never have been allowed to rise. It accordingly recommends that more attention should be given by the costings department to labour costs, and action taken when they appear to be too high.

The regularity with which examples of failure to profit by past experience occur in these reports is one of their most disquieting features. No less disturbing in its implications is the admission that the Sub-Committee has so far been unable to see the actual costs of scarcely any articles which have been delivered since the War began, so that it has been unable to find out so far whether in its judgment the State is in fact paying too much for its war supplies. Such an admission is more than an indication of inefficient administration and inadequate checks on excessive costs. It amounts to thwarting the prime purpose of Select Committee to watch over expenditure on the war services.

The wide view of its functions which the Committee has displayed in its reports, and the admirable balance of the reports, have won it already an established reputation, and its findings cannot be ignored without danger to the public weal. Even where, as in these latest reports, it makes numerous recommendations in matters of detail, such as constructive suggestions for preventing a break in production and unnecessary use of paper in sending out tenders and drawing up contracts, it is always clear that the wider issues are kept in mind, and that both policy and detail are being sifted by keen, analytical minds, untrammelled by tradition or departmentalism. The warnings conveyed so clearly and firmly in these latest reports are unmistakable. It is for scientific workers, with their fellow citizens, to see that there is no hiatus between this lucid thought and swift decisive action to eliminate the waste and handicaps which inefficient management, departmentalism or impatient but mistaken disregard of past experience, are placing on the development of our resources to their maximum capacity.

AMERICAN VIEWS ON MODERN CULTURE

Science, Philosophy and Religion
A Symposium. Pp. ix+443. (New York: Conference on Science, Philosophy and Religion, 1941.) 1.50 dollars.

THE papers contained in the present volume were prepared for a conference held in New York during September 9–11, 1940, the subject of the conference being "Science, Philosophy and Religion in their Relation to the Democratic Way of Life". Those who initiated the conference maintain that "civilization itself is threatened by the rise of totalitarian systems based on various anti-scientific, anti-philosophic, and anti-religious dogmas". They state—it is perhaps a hope rather than a conviction—that "our common background gives us a broad basis for a united, democratic American way of life". "This way of life must be based ultimately on the religious principle of the Fatherhood of God and the worth and dignity of Man when regarded as a child of God". The conference after its meeting appointed a committee to meet representatives of the Press: this committee overcame the temptations of humility and pronounced the papers submitted to be "contributions of unusual merit to American learning". Further meetings are planned to take place in 1941 and 1942.

In the volume before us there are, including two introductory papers, twenty-four separate contributions. They form a somewhat closely printed and substantial volume. Naturally, they are of varying length—and value. Practically all their authors are associated with American universities, an exception being the French Catholic philosopher, Jacques Maritain. (Throughout this review I shall refer to writers without honorific prefixes: the constant iteration of the title 'Professor' is irritating.)

As one reflects upon the plan of the conference and reads the resulting contributions, two questions of primary importance arise. Is there any vitally intimate relation between some particular political system and the true progress of science, philosophy and religion? Can any unity between these branches of knowledge be made effective at the present time? As regards religion, Christianity was born under a government which, though nominally that of an oligarchy, was in reality a military despotism. Philosophy came to its first maturity in the great days of Greece when Athens was a democracy with, however, a slave basis. It emerged in Christian Europe in the twelfth century when homes of learning, the monasteries, were an integral part of a feudal society. Science began its modern development when the Renaissance, followed by the Reformation, freed and stimulated the minds of men. Some of us would contend from these facts that there is no close connexion between political systems and the growth of true understanding. It is freedom to examine, to speculate, to question all theories and beliefs, which is vital to science. Without freedom of the mind, the philosopher works in chains, and the religious reformer chafes in sullen rebellion. The pluto-democracy which has evolved in the United States is not alone in giving such freedom.

Karl Darrow, of the Bell Telephone Laboratories, writes one of the most valuable contributions to the volume before us. He describes, accurately and not with the allusiveness which is too often a pretentious avoidance of careful thinking, the various revolutions in the fundamental ideas of physics which have taken place during the last half-century. His paper ends with the blunt inquiry: "But what has all this to do with the democratic way of life, or with the contrast between democratic and totalitarian systems"? He answers:

> "So far as the development of physics in particular and science in general is concerned, what it seems to require is a supply of talented people enabled and permitted to go their own ways, so that discovery may occur in whatever logical or capricious or ironical ways may be chosen by destiny. Non-interference is essential. If a government discourages some doctrine of physics because of a fancied clash between it and some political or economic dogma, it is adverse to physics. (Other sciences are more exposed to this danger, but even physics has not been exempt.) If a government impedes the free passage of scientific men or scientific writings to and fro across its frontier, it is adverse to the development of science even within that frontier. If a government denies opportunity to a group which has a great aptitude for science, it is doing harm to science within its own dominion, though some of the harm may be repaired by the benefit to science in other countries from the resulting emigration. If a government extinguishes a class which by breeding and inherited tradition and leisure is devoted to things of the mind, it is doing irrevocable harm to science. Everyone knows that it is mainly in totalitarian states that these things happen."

The quotation is long, but its content is good, sound sense.

The modern world reaches unity in its scientific conclusions. Is any unity possible in the domains of philosophy and religion? The present volume answers that question with an emphatic negative. There is no agreement as to "the religious principle of the Fatherhood of God". There is, moreover, no attempt to reach philosophical or religious unity. Mortimer J. Adler said truly: "The members of this Conference are not co-operatively seeking to agree about the truth, through the painful ordeal of intellectual debate. Each is content to express his own opinions, and to indulge everyone else in the opportunity for similar self-expression". Adler makes a forthright attack on the modern American professor. The latter avoids "what is demanded for fruitful intellectual procedure". "He will not subject himself to the rigours of public disputation". "He is indocile in the sense that, beyond the field of science, he cannot be instructed, because he acknowledges no ignorance". Is it wrong for an English ecclesiastic, remembering the history of the nineteenth century, to read these words with quiet pleasure?

Adler probably intended to expose the weakness of the present volume. It should be, and is not, constructive, a patient attempt to expose differences and to show what measure of unity is possible. Einstein, for example, contributes a brief paper in which he re-affirms the absolute determinism which is his philosophic creed:

> "The more a man is imbued with the ordered regularity of all events, the firmer becomes his conviction that there is no room left by the side of this ordered regularity for causes of a different nature. For him neither the rule of human nor the rule of Divine Will exists as an independent cause of natural events."

So, says Einstein, religious teachers must give up the doctrine of a personal God and "avail themselves of those forces which are capable of cultivating the Good, the True, and the Beautiful in humanity itself". We may challenge Einstein's metaphysics, as we may challenge that of Newton, without denying his greatness. The arguments in favour of his denial that the human will exists as an independent cause of natural events are, it has often been said, overwhelming—apart from the fact that the conclusion is contradicted by our daily experience. If Einstein is right, what are justice, mercy, honour but fancies which please us without affecting the course of events one jot. Whence come "the forces capable of cultivating the Good, the True, and the Beautiful" ? The term 'forces' is doubtless a metaphor, but of what reactions are they aspects? How can the cultivation which Einstein demands have results? Such questions are not missiles in a barren controversy. They raise issues vital to our civilization. The place of moral ideals in naturalism, or in similar creeds which reject a personal God, is not adequately answered by Harry A. Overstreet. Overstreet holds that when "the child-like religionist grows up," he dispenses altogether with the person-like word 'God'. "His religion is mature when he can say : "I believe in love, creator and sustainer of life. To the realization of love-in-life I devote myself". There are too many loose ends in this preaching. What relation has it to the stuff of which the universe is made or, I personally would add, to the mind which gave it form ?

It is perhaps too much to expect a neo-Thomist to join in constructive debate with men for whom his postulated entities are unintelligible. Maritain makes his demands clearly, but the answer, as I see it, can only be a polite 'if you think so, you think so'. In the less skilful hands of Anton C. Pegis, a defence of neo-Thomist philosophy takes the form of an attack on William of Ockham as the empiricist forerunner of the emancipated modern man. It leads up to the assertion that the liberation of the modern man is "a liberation from reason, from universality, from intelligibility, from order and from law".

Such Catholic philosophy is curiously indifferent to critical investigation of the New Testament : and yet the results of such investigation cannot be ignored if the Christian religion is to be integrated into the new cultural unity of the Western world. For this reason it is much to be regretted that in the volume before us there is no attempt to summarize the form which Christian belief must take as a consequence of our new knowledge of Christian origins. William F. Albright's discussion of "Archæology and Religion" is marked by an ultra-conservative bias. Some statements in it, as for example that recent papyri finds refute the idea that certain parts of the New Testament can be as late as A.D. 150, cannot be accepted. A dislike of "modern religious humanism" and the attribution to unspecified opponents of "the rationalistic dogma that all can be explained in terms of mathematics" are not adequate substitutes for a patient re-presentation of the essential principles of Christianity. Donald W. Riddle's "New Testament Study and the Time-Lag" does not supply the need. It is a relatively slight sketch of the history of New Testament critical scholarship. As the author writes of the time-lag, it is worth noting that he does not seem to have known that, when his paper was given, Loisy was already dead.

What has happened to the study of Latin in American universities ? On p. 93, we get *sub speciæ* : on p. 95, *humane laudis amore* : on p. 165, *ignorabinus.* Copernicus would be astonished to find that he wrote a book with the title "De Orbinum coelestium Revolutionibus" ; but Vesalius would be even more surprised to find that he was the author of "De humani corpori fabricia". E. W. Birmingham.

VICTORIAN TRAVELLER

The Rugged Flanks of Caucasus

By John F. Baddeley. Vol. 1. Pp. xv+272+22 plates. Vol. 2. Pp. ix+318+15 plates. (London : Oxford University Press, 1940.) 126*s*. net.

Mr. John F. Baddeley, the author, died a year ago at the age of eighty-five, just when he had made this book ready for the press. It is the narrative of his travels of some forty years ago.

As a very young man chance took Mr. Baddeley to Imperial Russia, and later on he engaged in business in connexion with the Caspian oil-fields, business which allowed him sufficient leisure to divert himself by riding on horseback for weeks together in and about the northern flanks of the Caucasus. Well versed in Russian, he relied on his servant and guide, an Ossetine, and a man of some standing among his own people, to act as interpreter among the tribesmen, by whom he was received with unfailing hospitality.

There is no doubt that the simplicity of Mr. Baddeley's tastes, his good sportsmanship and generosity, added to his genuine goodwill towards his fellow-men, made it possible for him to achieve an unusual intimacy of contact with the Caucasian villagers. He ate as they ate, slept where they slept, and listened eagerly to gossip, story and song by the fireside. All that he saw he recorded with care, and because these wanderings were among his happiest memories, the old note-books, diaries, photographs and sketches were brought out long afterwards in the days of his retirement and fashioned into a book.

The world Mr. Baddeley pictures is a vanished one, for he never revisited Russia after the War of 1914–18 and the Revolution. Yet he continued to interest himself in the history and literature of the Caucasus, and this travel record is enriched with the musings, memories and studies of the author's later years. He was able, for example, to compare the country as he saw it with the pictures drawn by many earlier travellers, incidentally indicting Klaproth of plagiarism and fraud. The Ossetines, the Galgais, the Khevsours and the Ingooshees were among the peoples visited, and the author has much to say of their legends, folklore, religious observances, manners and customs. He made, too, such notes on ethnology, archaeology, plants and animals as the neighbourhood afforded.

The day has passed, however, when the untrained, unscientific traveller can do more for the scientific investigator than tell him, perhaps, that there is something worth investigating. This is a work to be read for pleasure, the pleasure that can be derived from good English prose, from a finely produced book, and from the companionship of the unassuming young man who rode among the mountains, as well as of the well-read older man who lived among his books. A vice-president of the Georgian Historical Society, Mr. Baddeley was the possessor of a fine library of Georgian history and literature, from which he drew the copious annotations to his earlier travels which add so greatly to the interest of the volumes under review. This collection of books and journals he left to the London Library at his death.

MAKING AND BREAKING ELECTRICAL CIRCUITS

Electrical Contacts
By G. Windred. Pp. xii+403. (London: Macmillan and Co., Ltd., 1940.) 16*s.* net.

A GREAT deal of the results of research on technical problems remains in the form of papers in scientific and technical journals, not always easily accessible. A text-book which brings together the salient features of such specialized work can, therefore, be of great value, but the difficulties in writing such a book are numerous. In the first place, it may date quickly; secondly, a choice must be made as to whether the book is to appeal to those already specialists in the subject, or to those who have only a passing acquaintance with it. In either case the principal value of the book will lie in making a specific contribution to the subject by tying together as many loose ends as possible and getting the whole subject into correct perspective.

The book under review, however, appears to have augmented, rather than diminished, the number of loose ends, and includes some that do not actually exist in the subject. Mostly, too, there is very little real attempt to systematize existing knowledge. One of the reasons for this is that the author has tried to cover much too wide a field; another, that he evidently is very much more at home in practical matters than in theoretical argument. In spite of its defects, however, parts of the book will no doubt find a field of usefulness for students and those who have a general, but not too specialized, interest in the subject.

Chapter i is the only one which deals with contact theory proper. It is an interesting chapter, though here too there seems to be a lack of co-ordination and of completeness. The next two chapters, on joints in electrical conductors and on switch contacts, are purely descriptive and derive very little from the results established in Chapter i. Both these chapters are very uneven, with a tendency to repetition which can scarcely be excused.

Next come two long chapters, headed "Circuit Phenomena" and "Arcs and Discharges". Neither is actually germane and both are inadequate. The chapter on circuit phenomena begins with three pages describing resistance, capacity and inductance, which is surely superfluous in a book to be read by electrical engineers. It then goes on for the next forty pages to give a most elementary account of simple series single-phase circuits, including one or two equally elementary errors. The information offered concerning contacts might have been given in a couple of pages—indeed, it has practically been dealt with in the previous chapter. The chapter on arcs and discharges could only be justified if it were completely up to date and if exhaustive use had been made of this information in later chapters, in which case it should have come earlier. Instead, the treatment is so restricted that little application to contacts or circuit breaker problems can be made. The properties, or even existence, of the arc column (or plasma), which plays such a vital part in high-power circuit breakers, is barely mentioned. Arc suppression is dealt with under two headings—"Suppression Circuits" and "Arc Dispersion". The first is useful, but takes up too much space, while the second contents itself with the description of a few of the principal types of high-power circuit breakers. It is difficult to see why this should have been included. Switch contacts are fully described in a previous chapter (iii), including those used in high-power switches, whereas the subject of circuit breakers proper would require a volume or two to do justice to present knowledge. This part of the book, too, suffers from what might be called a failure to indicate scale. For example, multiple break is certainly advantageous for a certain range of voltage, but is much less so for low or high voltages.

The remainder of the book—two chapters on contact materials and "sliding contacts"—is better, even though the former tends to be somewhat of a catalogue of physical properties. The discussion of the properties required of contact materials might very well have been greatly extended, particularly on such aspects as contact bounce, contact wear and so on.

The indexing could be greatly improved; examples taken at random are "restriking voltage" and "recovery voltage", for which the index is of little help in showing one where to find an explanation of the difference between these terms.

It is to be hoped that in the second edition the author will enlarge the first three and the last two chapters at the expense of the others, and that some attempt will be made to form a logical structure in which the gaps in our present knowledge appear as missing steps and not merely as things one might like to know. At the moment, the book tends too much to the popular science type, namely, a collection of interesting facts arranged under headings, but with no proper background. Perhaps this is partly the fault of the present state of the subject.

Pleasing features of the book are its handy size, clear illustrations and imposing lists of references at the end of each chapter.

A. Morris Cassie.

CHILDREN'S IDEAS OF DEATH

The Child's Discovery of Death

A Study in Child Psychology. By Sylvia Anthony. (International Library of Psychology, Philosophy and Scientific Method.) Pp. xvi+231. (London: Kegan Paul and Co., Ltd., 1940.) 11*s.* 6*d.* net.

THIS is an investigation of the idea of death possessed by children of various ages, and of their emotional reaction to this idea. It is partly experimental (using the story-completion technique devised by Prof. Piaget of Geneva) and partly observational. The explanatory principles used are largely those of psycho-analysis, and the inquiry is motivated not merely by academic curiosity but also by the problems of the practical care of children, which are more than usually important at the present time.

The author finds that young children think more about death than is commonly believed, and that they are, in general, less prone to anxiety about it than adults suppose. She does not, therefore, defend the common grown-up desire to protect the child from all perception and thought of dead things or of death. On the other hand, she agrees that it is desirable to avoid stories or expressions of attitudes which tend to give ideas of death a frightening or horrible character. She also agrees with the psycho-analysts that feelings of guilt connected with the death of other people are common in children's fantasies on this subject, and suggests that the adult may help to relieve the morbidity of these feelings of guilt by allowing the child to express feelings of hostility as well as of affection towards those who have died.

In studying the development of ideas of death with advancing intelligence, the author finds a first stage (generally at less than five years of mental age) in which no meaning appears to be given to the word 'dead'. Later (from about six years of mental age onwards) there is clear understanding of the concept with reference to human beings, although it is some years later that reference is made to logical or biological essentials in explaining the meaning of death. The recognition of the inevitability of death in others generally precedes recognition of the inevitability of the child's own death, and this latter may be found an idea too painful for ready admission into consciousness, and ideas of living for ever may be elaborated.

A lasting refusal to allow into consciousness the idea of the reality of death may lead to a disintegration of personality through a perpetual conflict between reality as the child sees it and the reality which is a basis for the society he lives in. Such a refusal may be due to an inborn predisposition to reject unpleasant ideas, but the author is more inclined to the idea that it commonly results from such an emotional experience as the too early loss by death of a loved person which makes the idea of death more than normally painful at the critical stage. In either case the child will need psychotherapeutic help, and the understanding adult may help to avoid a repression of this kind by avoiding a morbid expression of the idea of death by his or her own words and example.

R. H. Thouless.

Chambers's Technical Dictionary

Comprising Terms used in Pure and Applied Science, Medicine, the Chief Manufacturing Industries, Engineering, Construction, the Mechanic Trades. Edited by C. F. Tweney and Dr. L. E. C. Hughes. Pp. viii+960. (London and Edinburgh: W. and R. Chambers, Ltd., 1940.) 15*s.* net.

AN accurate and reasonably comprehensive technical dictionary has become an almost indispensable adjunct to the equipment of the scientific worker, and also to that of the layman who desires to march with the times. The prodigious growth of knowledge in the natural sciences and their applications has, moreover, necessitated the coinage of a multitude of new words, and if a majority of these can be found, alongside the old ones, within the limits of a single volume, much time is saved and efficiency gained. No single technical dictionary can aspire to completeness, but every good one should include the essential words and expressions, and be available at moderate cost.

Judged by the above criteria, "Chambers's Technical Dictionary" comes out very well indeed. It contains an extraordinary amount of condensed information, which, so far as the writer is competent to judge, is both reliable and up to date. Brevity is naturally its soul, and should the specialist complain that excessive condensation must entail slight inaccuracies, his remedy is to consult an encyclopædia and not a dictionary. A minor criticism can be advanced against what appears to be arbitrary classification, for many of the words included in one or other of the 124 categories which the authors have adopted might equally well have been placed in another. Thus there does not seem any special reason why words like 'adsorption', 'aerosol', 'molecule', and 'osmotic pressure' should be termed 'chemical' rather than 'physical'; but classifications are always fallible, and like speculative hypotheses, must be scrapped when they are out of date. Among the few omissions noted is the word 'chemotherapy', and agricultural terms in general, though a number of these occur under 'botany'. On the other hand, the inclusion of a large number of medical terms comes as a welcome surprise.

The success of this book is due to the excellent work of a large team of scientific contributors (whose names are not, for the most part, well known), and to the judgment of the two editors; to them for their ability, and to the publishers for their enterprise, the thanks of the scientific and technical world will be readily given. E. H. T.

Volumetric and Phase Behavior of Hydrocarbons

By Prof. Bruce H. Sage and Prof. William N. Lacey. (Associated with Research Project 37 of the American Petroleum Institute.) Pp. xii+299. (Stanford University, Calif.: Stanford University Press; London: Oxford University Press, 1939.) 28*s.* net.

THIS book is mainly concerned with physicochemical principles affecting petroleum technology. It begins with some mathematical and thermodynamic principles, then deals with one, two, and multi-component systems largely from the experimental point of view, the text being illustrated by many clear diagrams. There are references to recent literature. The phase rule and thermodynamics are really the basis of the treatment, but the correlation of experimental data is what is emphasized throughout. When quantitative knowledge of the physicochemical properties is available it is introduced. The section on multi-component systems should be particularly interesting to the petroleum specialist. An appendix deals with retrograde condensation.

The book is a courageous and successful attempt to introduce the principles of chemical thermodynamics into a region of technical application where they can be of real importance and significance. In recent years much work has been done on the physico-chemical properties of the individual hydrocarbons, and a book of this character will help in pointing out its significance to the technologist.

Chiltern Country

By H. J. Massingham. (The Face of Britain Series.) Pp. viii+120+66 plates. (London: B. T. Batsford, Ltd., 1940.) 8*s.* 6*d.* net.

English Lakeland

By Doreen Wallace. (The Face of Britain Series.) Pp. viii+120+66 plates. (London: B. T. Batsford, Ltd., 1940.) 8*s.* 6*d.* net.

THESE books are the latest additions to the volumes in the series entitled "The Face of Britain". Numerous photographs of the two districts dealt with have been collected, and excellently reproduced. If selection be the criterion of art, almost every one of these photographs is a work of art, for they show both the diligence and the good taste needed for rightly directing the camera, the wide angle of which makes it difficult to exclude inharmonious objects.

Mr. Massingham describes the Chiltern country with a wealth of detail, both in relation to natural features and rural industries (such as chair-making and "bodger" work), which still, fortunately, survive in the beech wood districts. Attractive comments are made on rural architecture, as, for example, in describing the outside chimney of the cottage "reaching its brick stack up from tiled shoulders".

The first chapter of Doreen Wallace's volume on "English Lakeland" is appropriately entitled "Tourists' Paradise". The author writes with more intimate knowledge than that of a tourist, having been born and brought up in the district. The well-informed account of sheep farming on the fells provides a true picture of the relation of life and landscape which is such an important element in the æsthetics of scenery.

With reference to the opinions of the author on the appreciation of Lakeland scenery, there is one point in which we feel bound to record disagreement. We are told, p. 11, that "Wordsworth had the woolly mind of the truly good". His "Guide Through the English Lakes", so far from being evidence of a "woolly mind", is one of the clearest and most accurate analyses of natural scenery that has ever been written.

HENRY E. ARMSTRONG*

By Dr. E. F. Armstrong, F.R.S.

MY father was essentially artistic in temperament and had a fine sensitivity for many forms of art. Thus he had an ear for and enjoyed music, he derived much enjoyment from his black-and-white pictures, and took an interest in modern pottery. He was unable to take a symphony to pieces, to talk of good and bad construction in composition, or to argue about schools of painting; but people who do understand these things are often bores and hypocrites of the first order. A good "companion in music" of his writes: "times out of number I have sat with him on the hardest seats imaginable in order that we should go to three concerts in misery rather than to one in comfort. The dear old man was hypnotized by Wagner and Haydn, Beethoven and Mozart, but could not say why—and thank God for it. Your father's appreciation of the arts was, I think, that of the true Artist: underneath the man who possessed a scientific approach to most things lay the makings of a great Artist."

He had an intense worship for colour either in Nature, on textiles, or elsewhere. Some association of eye effect with the chemical problem of origin gave him a feeling of physical well-being when he viewed a real patch of colour. Some of his happiest days were those spent among the autumn colours, and he wrote with deep feeling about them. His palate was particularly sensitive, especially in later years, to flavour and odour, gifts which led him to find keen enjoyment in fine wines and good food. He never smoked and hated the smell of tobacco except from the best cigars, and in consequence perhaps had a palate of extreme delicacy. In all these matters he was always ready to be educated and acquired much knowledge of the "bitten line" through my collection of etchings, and of wines of virtue through André Simon, greatest and most genial of good companions. It might be said he had a nature abundant in resource which found every moment full of charm. He never let himself be cabined, cribbed, or confined. This wide range of interests often prevented him from completing a piece of work undertaken with enthusiasm, new problems diverting his attention. He set himself a high standard in his writing and would not allow publication until he was satisfied with the final draft.

He definitely lacked the engineer's mentality and the appreciation of what the engineer does. Perhaps for this reason he was never in close association with his colleague, Unwin, and other leaders of engineering. He tried hard to put the ideal of science and the detective method of scientific inquiry before many generations of engineering students at an age when perhaps they were least receptive of aught else but the practical side of engineering, and perhaps in consequence of failure to interest the many became biased against the engineering mentality.

The students of the Chemical Department at the Central Technical College were few in number, but they made up in quality for any lack of quantity. Practically all of them came to the front in their chosen paths; they were forced to do so by the Professor who admonished them when necessary for their own good. In his day he had a greater personal influence on his men both at College and after leaving than any other professor. He was rewarded when at one period his ex-students or staff held so many of the chairs of chemistry; for example, Wynne, Kipping, Pope, Lapworth, Lowry, Forster, Philip, Crompton, and Percival in Great Britain, and Worley in New Zealand, whilst E. M. Rich became chief education officer to the London County Council.

There exists a list of the careers of his old students showing the many branches of industry into which they have penetrated. Most of them have left their mark on their particular industry either by discovery or by rising to high positions in it, and one is inclined to wonder, after studying it, what would have been the position of chemical industry in Great Britain prior to 1914 if Armstrong had chosen the other path at Finsbury and created there a great school of training for the chemical industries.

It is important to emphasize my father's personal interest in his students, both when at college and throughout their careers. He took the greatest pride in their achievements and worked unceasingly for their promotion. Apart from those he actually taught, there were perhaps quite as many chemists who discussed their researches with him and received much help and guidance, often daily letters, coupled with the frankest criticism. Many others, again, came for advice regarding their careers. His enthusiasm for those who accomplished anything knew no bounds and he threw all his influence behind them. One recalls, for example, a shy schoolmaster, H. B. Baker, working on the reactions of dried gases. His brilliant career is well known. My father's correspondence contains a large number of highly appreciative letters from distinguished men, often written on the occasion of their election to the Royal Society.

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* Part of the first Armstrong Memorial Lecture of the Society of Chemical Industry, delivered on February 3.

Armstrong made a point of knowing everybody in chemistry and as many as he could in other sciences; he specially encouraged the younger men and liked them to make the pilgrimage to his house at Lewisham on Sunday. There are many letters testifying to the influence he had on these afternoons. After tea he used to encourage them to talk about their work, and often late in the evening he would write them some suggestions to overcome their difficulties.

Armstrong had a great capacity for making friends and, what is rarer, of continuing to make new friends in advancing years; they had to be men of independent thought. He had the trait of hero worship in his make-up; all his life he worshipped his teachers Frankland and Kolbe and his friend Dewar, and he had the utmost admiration for many other of his friends; this was particularly brought out in his obituary notices, which were models of graceful feeling. He wrote in reference to Ellwood Hendrick—"A friend cannot be defined. He is never made: he comes, when and how who shall say? Only where the wind listeth. He is the greatest and rarest of discoveries: the inestimable loss." Of such quality was the friendship with Dewar, Messel, W. H. Perkin, senr., the Browns, Horace and Adrian.

My father always felt he owed much to the very remarkable scientific quartette at Burton-on-Trent—Peter Griess, Cornelius O'Sullivan and the Browns—all active in the scientific service of brewing. The achievements and influence of these four men on chemical science have been profound. Armstrong has done full justice to it—"They sought neither gain nor applause; love of their art was their guiding light; they were led solely by desire to explore its fields, to grasp its value, to display its beauties."

He frequently went to Burton and corresponded closely with his friends; the introduction to brewing gave him a life interest in this subject, with which he maintained close contact all his life. He pleased to be a good-humoured critic of the quality both of the product and of the science put into it on diverse occasions, and had many friends in the industry. I myself was at one time destined for Burton, but Fate turned my path to biscuits instead of beer.

As a young man my father was extremely earnest and unsociable; my mother had the greatest difficulty in getting him to go anywhere; he paid only a very few calls on Sunday mornings to old family friends. His whole life was devoted to his work at the College, to teaching and research and to affairs of the Chemical Society. When he came home he wrote letters until late into the night. It was much later in life that he allowed the latent social side to develop, when he had leisure to go about and meet people.

My father shone also as a host; the formal dinner parties at Lewisham were in the true Victorian style, with Clarke, the laboratory attendant, called in as a waiter. The guests were most carefully paired and many interesting people came to the house. One such party included Sir George Robertson, the hero of Chitral, and Prince Kropotkin, then a prominent Russian revolutionary, though to-day his politics would be considered the palest of pink. We had no cellar book like Saintsbury, but a visitors' book was maintained from 1894 and in time it became an honour to be included in it. It is truly international; every American or German chemist who came to London made the journey to Granville Park, generally on a Sunday, and the names of few of the British chemists of the day are missing. A frequent entry is that of Joji Sakurai. His is the last name in the book; he called on May 21, 1937, when my father was confined to his room. My sister tells me that at 3 o'clock in the afternoon a half bottle of champagne was sent for so that the two old gentlemen might drink to one another. Sakurai passed away on January 28, 1939.

In his later years Armstrong became the guest *par excellence*. Adorned with his coloured waistcoats, his one personal vanity, though he claimed them as an advertisement for the achievements of the dye industry, he became a much-sought table companion at the dinners of the Omar Khayyam Club, the Saintsbury Club, the Wine and Food Society and many similar occasions; he enjoyed also the banquets of the London Livery Companies. His knowledge was so wide, his range of subjects so varied, his views so original and outspoken that they aroused the interest of his table companions. Very often correspondence and friendships followed these chance meetings.

One dining club merits special mention, namely, the original Chemical Club, which was an exclusive body, limited to forty chemists elected by ballot; it met monthly on the same days as the Chemical Society. Formed in November, 1872, the first secretary was Pedler, but Armstrong took on the task in the following February and continued to perform it for many years until the constitution changed and the dining club became associated with the Council of the Society. The history of most dining clubs is much the same. They either become too formal and dull and so lapse, or they depend on the enthusiasm of one man and a set of regular participants. The old Chemical Club took the latter path; it became entirely informal, minutes, rules and subscriptions were in abeyance and it relied on Armstrong, or rather Mrs. Armstrong, to send out the monthly cards and order the dinners. Here the older men were met on level terms by the younger, and many enduring friendships were formed. Here also it was possible to entertain appropriately distinguished foreign visitors to our shores.

My father took delight also, when the Chemical Dining Club was no more, in arranging dinners at the Athenæum and elsewhere to distinguished visitors to London, when representative Londoners widely chosen were gathered to meet them.

The successor to the Chemical Club has been the Catalysts, now also a mature body. Armstrong was seldom absent from these dinners and did much to make them enjoyable. He was a regular chairman also at the monthly lunch meetings of the Old Centralians, a gathering which gave him lively satisfaction.

> "He that enlarges his curiosity after the works of nature demonstrably multiplies the inlets to happiness."—Johnson, Rambler No. 5.

Academic life gave my father full opportunity for holidays, and he enjoyed the absence from London. He enjoyed walking and continued it into the 'eighties and would have no other sport. I remember Lockyer trying to get him to take up golf on Blackheath. A regular Sunday morning walk across Blackheath to the Observatory in Greenwich Park will always be associated by me with his memory.

In his early youth he walked a good deal in Scotland; later he went abroad to Switzerland and Norway, then just opening up for tourists, often in company with Tilden or Clowes.

For the family holidays which played so large a part in his life, Margate was at first the chosen place. Here he had Lauder-Brunton and Hardy, the eye specialist, among others, to see; Lockyer was at Westgate. In later years the geological general practitioner Dr. Arthur Rowe was his great friend there. We were taught at an early age to walk; to study the changes in the soft chalk, in that district very rapid; to look for fossils; to visit churches and to learn the history of the Roman occupation and of the Cinque Ports.

Beginning about 1886, Lyme Regis was chosen for Easter. The Tildens came too, also Wynne; Lord Lister lived at the top of the hill. By that time we youngsters could walk farther, but even so the ascent of Golden Cap was a feat, and more than one visitor found the two miles or more of shingle along the face of the intervening hill enough for that holiday.

A visit of the Geologists' Association took us to Swanage one Easter (1895) and there and then the cottage on the pier was secured for the summer and for many future holidays. Here the family was trained in nature study—to collect, to observe, to record as part of a normal enjoyable holiday. One of his children should have become a biologist, nurtured under such environment, but heredity or some other factor proved too much for us and we have remained normal people taking perhaps a special interest in our holidays and collecting as a hobby. The Isle of Purbeck is still a unique centre for study with three geological ages in juxtaposition, involving three different flora and fauna. My father gave much time to his coastal photography here; it involved carrying around a heavy camera, tripod and glass plates, and sundry adventures by way of trespass or in boats to secure pictures of selected sections.

We had the ambition to walk round the English coast on the coastguards' path and in course of time accomplished all the worth-while sections, writing up the experiences in the form of illustrated and annotated log books. We were induced in this way to look up the history or other information relating to places and objects, and so learnt at an early age how to consult books of reference and make a précis of information. This training was of the utmost value; it helped to teach us to learn easily anything which appeared of interest, though we were as stubborn as other children in refusing to learn the dull stuff taught at school. None of us was high in class except in our pet subjects which we mastered with ease.

The transference of affection to the Lake District came later, the introduction being effected on a Geologists' Association trip led by Marr. Here Armstrong had his happiest days and he returned to Manesty Farm near Grange, with its unique views into the jaws of Borrowdale in the one direction and across Derwentwater to Skiddaw and Saddleback in the other, as often as possible each year for many years. Long walks were carefully chosen to give variety and interest, and formed a programme of increasing severity to suit all weather conditions. Some of the most arduous gave him greatest joy; the long grind round to the top of Grasmoor, the attack on Gable from Green Gable via the side of the slate quarry on Honister, the walk up Ennerdale and the climb out at the head of the valley, the ascent from Seathwaite to below Great End and the climb up Cust Gulley were some of his favourites. Another was the ridge walk to Causey Pike followed by an abrupt descent that often caused havoc to his companions, in which he took secret delight. The use of a car to lessen road distances and make new walks possible in later years added greatly to his enjoyment.

He loved having visitors at Manesty, and very many came there; he would talk freely on the hills and in the sitting room on slack or wet days and gave mental stimulus, as only he knew how, to not a few. He made friends with the parson, Canon Rawnsley, at Keswick, and took an active part in all the fights to preserve the Lake District against vandalism. The greatest joys of all to him were the days when the snow came and gave yet one more touch to the kaleidoscope of colour on rock and hillside. Those who knew him in the hills perhaps saw him at his best and most versatile —a philosopher, wise in very varied knowledge, more full of zeal than tolerance, perhaps, putting the cause above worldly ambition.

Armstrong was strongly individualistic and gloried in being so; in his later years he enjoyed being provocative and exaggerated his attacks—in his own words—"there is more fun in laying about you." As a freelance without occupation he had not often the opportunity to be constructive. In a wiser age perhaps his abilities would have been more utilized.

It must be remembered that he was the product of an age when transport was slow and communication limited—the horse and buggy days of our American cousins. Whereas there were then many small local worlds, to-day there is only one large world in which the radio brings an event to the notice of everyone within a few seconds of its happening. Science and philosophy to-day more than ever seek to submerge the particular in the universal; there is little room for the unique individual, who is looked on as irrational. The desire of the human mind is for unification; all that is, was, or ever shall be, originates from one source. Most students to-day accept this view as a doctrine of scientific faith and regard one who combats it as outside reason. Hence perhaps the failure of the youngest generation to appreciate Armstrong's greatness. Had he lived fifty years earlier he would have been venerated for the very reason that he had been criticized. Hence the fact that his outpourings in scientific journals were most appreciated by older men and in the United States, which is still largely individualistic.

As an adventurer Armstrong could not understand the satisfaction to be gained from committees and conferences. Immediate action appealed to him; the need of the cause was too urgent to allow time in which to placate the opposition. It has been said that disapproval occupies the greater part of our conversation; it is tempting to say how a job ought to be done when one is denied the opportunity to do it.

Progress, educational or otherwise, means hard fighting not for one lifetime only but for generations. Those whom Priestley termed "the men who will never learn" are strong. Meredith's simile of the hair, in that remarkable work the "The Shaving of Shagpat", as illustrative of the errors, injustices, or illusions which an enormous effort is required to destroy, appealed very much to my father. His ideals were those for which we are fighting to-day. To him they were clear and patent. In an address in 1935 to the Frankland Lancastrian Society he wrote, "as human beings most of us are only interested in ourselves. | We have to learn without delay how much more we might, could, and should do for ourselves." He outlined some of the immediate needs of the nation and emphasized how the inquiry will demand an extraordinary use of intelligence which in large measure will have to be developed for the purpose. We are trying to do these very things in 1940–41, under difficulties of which "the hair" is the greatest.

My father was a great reader. Probably no one knew the chemical literature up to a certain period better than he did and he possessed a most retentive memory. In later years with more leisure he read very widely. He appreciated that "the worth of reading is in its after effects; it forces big thoughts and compels the recognition of new aspects of common things." His writings are full of quotations, Lewis Carroll being one of his favourite authors for this purpose.

He mentions the influence of Trench's book "The Study of Words" on his youthful impressions and his then habit of omnivorous reading. He gladly returned to this when he gave up his professorship. The influence of good companions is to be found in his later writings, which were often brilliant apart from their pungency.

Some words of Lafcadio Hearn are, I think, appropriate to him, namely, that if a man has a very powerful imagination as well as a very large sympathy the study of science alone will give him everything he needs. "He can get the water of emotion out of any desert of dry facts." Hearn says that such men are very rare, and students of science, who normally tend to be hard, are counselled to read emotional literature. I think it will be agreed that his addresses of later years are full of feeling; he took enormous pains with them.

My father had a wonderful old age; he found something to do every day, kind friends to encourage him and though his hearing began to fail, his vitality and mental energy were unabated. Only on the death of his wife in the last days of 1935 did ill-health overtake him. He bore a long period in his room with great patience and preserved his mental faculties to within a week of his passing on.

He accepted the creed of Ben Ezra, who so boldly declares that old age is better than youth simply because of its being the time of knowledge and understanding.

He has marked Browning's verse :

> "Thoughts hardly to be packed
> Into a narrow act,
> Fancies that broke through language and escaped
> All I could never be
> All men ignored in me
> This I was worth to God, whose wheel the pitcher shaped."

He hoped much from heredity and believed the best qualities of a man may appear in his grandchildren or great grandchildren ; they furnish the proof of the worth of the ancestor, using the words of Lafcadio Hearn. The tragic death of his grandson, Kenneth Frankland Armstrong, in whose career H. E. A. took so much pride, was perhaps the greatest blow of his life.

I have sought to trace the life-history of a versatile, individualistic man ; one who kept himself fit in body and also in mind ; one who gave unstintingly of his best to many causes without thought of fame or honour for himself ; it was indeed his nature to decline all such. If the task has been achieved we have seen what is so well expressed in the words of Walt Whitman :

> "Journeyers gaily with their own youth,
> Journeyers with their bearded and well-grained manhood,
> Journeyers with their own sublime old age :
> Old age, calm expanded, broad with the haughty breadth of the universe."

'WORKING-CLASS' EARNINGS AND EXPENDITURE

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DEFINITION OF 'COST OF LIVING'

THE nominal wages of a working man are in the main governed by the demand for and the supply of such skill as he possesses. His real wages—what he can buy with his money—depend upon the movement of prices. During a war, the mounting cost of living invariably directs public attention to the need for regulating wages so that real and nominal shall keep step. The 'Cost of Living' Index was designed for this purpose in 1914 and has been widely used ever since.

'Living' clearly has a very different meaning in different social circles, so that changes in the cost of living of different classes cannot be accurately measured with the same instrument. Agreement must accordingly be reached upon a standard, a definition of living, if we are to measure its changing cost. The purpose of the Ministry of Labour Index is to measure the average increase in the cost of maintaining unchanged a standard of living of the working-classes as defined in 1914. Strictly, therefore, this index is a measure of price changes—the mean change in price of an aggregate of certain specified commodities the enjoyment of which constitutes 'living'. The choice of these commodities was based on an analysis of 1944 urban working-class family budgets collected by the Board of Trade in 1904, but between 1904 and 1914 the Sumner Cost of Living Committee (1918) reported that "no considerable changes took place in the mode or standard of living". These budgets indicated that, in spite of a wide divergence in expenditure between families, certain needs are common to them all. These basic needs alone, things which from time to time practically every family buys, are used to define living. The number included in the 1914 calculations was severely limited ; the list of foods, for example, contained only fourteen commodities : no fruit and no vegetables, except potatoes, were included. In such respects the standard of living of the working-classes has risen considerably since the War of 1914–18 ; to this improvement the cultivation of allotments, advance in the science of preserving and storing food, quicker transport from abroad have all contributed. Consequently, an analysis of household budgets to-day reveals a marked extension of the field of basic expenditure.

NEW COLLECTION OF HOUSEHOLD BUDGETS

The first results of the recent and most elaborate budget inquiry ever undertaken in Great Britain by a Government department were published in the *Ministry of Labour Gazette*, December 1940. The households invited to keep budgets—and encouraged to do so by a small payment for each approved budget—were determined by a purely random choice of names from the registers of adult workers insured against unemployment, all districts throughout the United Kingdom being adequately represented. Certain important classes of non-insured workers were also included, but applicants for unemployment assistance (that is, long-standing cases of unemployment) were excluded. With this reservation the households represented may be described as those of manual workers, and non-manual earners of salaries up to £5 a week engaged in industrial, commercial or clerical occupations. Agricultural workers do not concern us in this article. In Great Britain alone, 31,000 households were visited; about 9,000 proved to be outside the scope of the inquiry or were ruled out for some other good reason; of the remainder, nearly 60 per cent co-operated. So high a return in this type of investigation exceeded expectations. It reflects great credit on the Statistical Division of the Ministry of Labour directing it, on the employment exchanges and advisory committees throughout the country, and on the thousands of voluntary workers who formed the direct link with the families visited. The majority of these families kept a satisfactory record of expenditure for four specified weeks, in October 1937, and in January, April, and July, 1938. We may confine our attention to these 8905 households, since the addition of budgets kept for a shorter period makes no significant difference in the figures.

MEAN SIZE OF HOUSEHOLD AND ACCOMMODATION

The information so far available from these new budgets is best summarized in the form of averages. Thus, the average budget family was composed of 3¾ persons, including 2½ adults over eighteen years of age and one child under fourteen. Two persons per family were dependants and the earners worked on the average five days a week. Two per cent of the families—mostly miners—lived rent free in dwellings provided by their employers; nearly 18 per cent either owned or were buying their houses; the remaining 80 per cent paid rent and the mean number of rooms occupied was 3·9. The average weekly rent (including rates and cost of purchase when relevant) was 10*s*. 10*d*.

EXPENDITURE

The average weekly expenditure per family on food was 34*s*. 1*d*. Of this, 10*s*. was allocated to meat (including bacon, fish, etc.), 9*s*. to dairy produce, 5*s*. to bread, flour and cakes. The mean consumption of meat and bacon per family was nearly 6 lb. each week, of butter and margarine 2½ lb., of sugar 4¾ lb., of eggs two a day. The average consumption of bread and of potatoes by each person was just over ½ lb. a day, while that of milk was appreciably less than ½ pint a day. The change in distribution of expenditure as compared with 1914 and the trend towards middle-class expenditure, as revealed in the accompanying table, is of particular interest.

PROPORTIONAL DISTRIBUTION OF EXPENDITURE ON FOOD.

Expenditure on	Working-class budgets		A middle-class sample
	1914* %	1937–1938 %	1926* %
Meat, fish, etc.	32·0	31·2	37·5
Bread, flour, cakes	19·3	15·7	12·2
Dairy produce	22·3	27·9	25·9
Vegetables, fruit	9·7	13·3	13·2
Sugar, jam	7·5	5·1	5·1
Tea, coffee, cocoa	6·6	5·8	4·6
Oatmeal, rice, etc.	2·5	1·0	1·5

* Derived from an article by D. Caradog Jones (*J. Roy. Statistical Soc.*, 91, Pt. 4, Table xiii).

The weekly consumption of coal amounted on the average to 1¾ cwt. for each family, the expenditure on fuel and light together being 6*s*. 5*d*. a week. Out of the 8905 households who kept satisfactory budgets of their total expenditure for four weeks, 2100 were persuaded to keep a detailed record of what they spent on clothing and footwear for twelve months. On this additional and more reliable evidence the total average expenditure on clothing is estimated at 8*s*. 1*d*. a week per family.

DISTRIBUTION OF TOTAL EXPENDITURE.

Expenditure on	Working class			A middle-class sample
	1937–38	1914*	1937–38	1926*
(1)	(2)	(3)	(4)	(5)
	s. d.	%	%	%
Food	34 1	60	40	32
Rent and rates	10 10	16	13	14½
Clothing	8 1	12	9½	11
Fuel and light	6 5	8	7½	4½
Miscellaneous	25 7	4	30	38
Total	85 0	100	100	100

* *J. Roy. Statistical Soc.*, 91, Pt. 4, Table xii.

Acting on the principle of including in the calculation of the Cost of Living Index only basic needs, the Ministry of Labour has hitherto given very small weight to expenditure on items other than the four main groups already considered. Their miscellaneous group included only such cleaning materials as soap and soda; domestic ironmongery, brushware and pottery; tobacco and cigarettes; fares; and newspapers. These items between them account in the new budgets for an expenditure of 7*s*. 4*d*. a week on the average. But in addition, these budgets include compulsory national insurance, costing 2*s*. 1*d*. per family, while voluntary insurance premiums and trade union subscriptions together amount to 3*s*. 9*d*., whereas the total average expenditure on all items in the miscellaneous group is 25*s.* 7*d.* The difference is made up of house furnishings (2*s.* 7*d.*), entertainment (1*s.* 4½*d.*), hospital, medical and dental charges (1*s.* 8*d.*) and other expenses.

The ultimate result of this analysis of present-day expenditure is summarized in columns 2 and 4 of the accompanying table, and again comparison is made with working-class expenditure in 1914 and middle-class expenditure in 1926, bringing out as before the closer approach of the working-class towards the middle-class type of distribution.

EFFECT OF NEW WEIGHTING ON COST OF LIVING INDEX

What difference would the use of the new weights shown in column 4 above make in the Cost of Living Index ? To answer this question we must understand precisely what it means. Suppose we wish to compare costs at two given dates, July 1914 and the period 1937–38 to which the new budgets relate. The index at present in use measures the increase in the cost of maintaining unchanged the 1914 standard of living as already defined. There is only one correct way of doing this, and the answer is given month by month in the *Ministry of Labour Gazette.* If we calculate the mean of the official price indexes at the four dates nearest to the budget weeks, we find that food had risen 42 per cent, rent and rates 59½, clothing 110, fuel and light 80½, and the miscellaneous group 75 per cent between July 1914 and 1937–38. Each of these percentages, *by definition,* must be weighted according to its importance as judged by the average proportional expenditure upon the corresponding group in July 1914. In other words, the appropriate weights are those given in column 3 of the accompanying table. This leads to the conclusion that the cost in 1937–38 of 'living' as defined in 1914, was 57 per cent above the 1914 level.

But suppose we change our standard and proceed to compare with this figure the 1914 cost of buying the commodities which constituted 'living' as defined by the average of the 1937–38 budgets. We start now with the distribution of expenditure shown in columns 2 and 4 of the table. To find the cost of this average budget in July 1914 we must allow for the mean change in price of each of the five groups between 1914 and 1937–38 given above. This done, we find that the budget which cost 85*s.* in 1937–38 would have cost only 52*s.* 9*d.* in 1914. In other words, the average budget of 1937–38 cost 61 per cent more at that period than it would have cost in July 1914. If, therefore, we wish to define 'living' according to the present-day standard in place of that of 1914, the result will be a rise in the 'cost of living' from 100 to 161 instead of 100 to 157. It may be presumed that this difference is much less than the critics of the old Cost of Living Index anticipated. It illustrates the validity of the statistical principle that the weighting of price movements—normally based on a selected standard of living—is of less importance than the price movements themselves, which are independent of the particular standard selected and determined afresh each month.

RELATION OF EARNINGS TO EXPENDITURE

One further question of interest remains. How is the average standard of living, represented by these budgets, related to the present-day level of earnings ? To answer this question use can be made of data given in the November and December issues of the *Ministry of Labour Gazette* 1940, concerning average earnings in the principal industries at July 1940. Agriculture and mining are two notable omissions from the industries listed, but it is reasonable to omit them as we are only concerned with urban budgets. It will be appropriate also to confine our attention to men's earnings in dealing with household expenditure ; and in order to obtain a composite average it will suffice to weight the earnings in different industries by the number of occupied males, aged 14+ , in each as given by the 1931 Census for England and Wales. The resulting average of weekly earnings is 87*s.* It should be added that under war conditions two industrial groups, by reason of the numbers employed, have a predominating influence in producing this result, namely, the metal, engineering, and shipbuilding group and the transport and storage group. Another point to be noted is that average wage rates would, of course, be at a distinctly lower level. We have also information, in the same two issues of the *Labour Gazette,* as to the percentage increase in men's average earnings for each of the same industries since October 1938, a date more closely approximating to the budgets period. By weighting these as before it may be estimated in round numbers that average earnings in October 1938, for these combined industrial groups, were in the neighbourhood of 70*s.* a week. Bearing in mind that on the average there were 1·75 earners per household, this would give an ample margin to meet a weekly family expenditure of 85*s.*, even allowing for the probability that all earnings do not go towards housekeeping.

Averages, useful as they are, do not bring out the light and shadow in the picture. If we could be also told what the budgets reveal as to range of spending, we should have fairly accurate and unique information as to the relative poverty and wealth of a large section of the population.

THE BANANA IN CENTRAL AMERICA

III. PANAMA DISEASE

BY PROF. C. W. WARDLAW,
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DURING recent years in Jamaica and Central America, the spread and intensification of leaf disease of bananas, *Cercospora musæ*, Zimm., has tended to deflect public attention from another epidemic disease of long standing and of great economic importance, namely, Panama or wilt disease, caused by the soil-borne fungus, *Fusarium oxysporum cubense*. To-day the question is often asked as to which of the two diseases presents the greater danger to the industry. During 1935–40, an observer, surveying the almost incredible damage wrought by leaf disease in such a brief space of time, and aware of the much slower spread of wilt disease, might well have been tempted to regard the former as the greater evil, assuming that he did not take refuge, as Sir Roger de Coverley almost certainly would have done in the circumstances, in the view that there was much to be said on both sides. Among the more enlightened members of the planting community, however, the opinion is held that wilt disease is the more serious problem since leaf disease can be, and is being, controlled, whereas wilt disease can not. From the investigational point of view, leaf disease, while not a simple problem, nevertheless is not beset with those complications which are inseparable from the activities of soil pathogens, and whereas it is known that bananas resistant to wilt disease can be obtained by hybridization, the work is slow because of technical difficulties. So far, indeed, no hybrid has been obtained which possesses the many qualities which have made the Gros Michel the commercial banana *par excellence*. Moreover, it is apparent that some considerable time must elapse before such a hybrid is produced. In some respects, therefore, the Panama disease situation remains very much what it has been for many years. The disease, of course, has continued to spread and has led to the discontinuation of banana growing in many areas.

The passage of time has not lessened the many curious and unexplained aspects of Panama disease. Some instances may be cited. Perhaps one of the most surprising situations is to be found on the lower Ullua River in the Republic of Honduras, where, notwithstanding periodic inundations by flood water carrying debris from affected areas higher up, large areas have remained in a high state of production, with a negligible amount of wilt disease, for a period assessed at fifty years. By contrast, areas inland from La Ceiba have been seriously affected by disease within two years of planting. There, the evidence is suggestive of a pre-cultivation dispersal of the pathogen during the periodic flooding of the forests adjacent to the river, wilt disease having been observed in areas scoured by the flood water higher up. On being planted with bananas, such areas have rapidly gone out with disease. Many instances are known of the 'resistance' of older areas and the 'susceptibility' of new. Whether conditions on the floor of virgin forests are specially favourable for the propagation and distribution of *F. cubense* has not, so far as I am aware, been investigated in detail, but the evidence strongly suggests that they are.

A particularly obscure problem is presented in certain areas which for many years have appeared to possess 'resistance' to the disease but which suddenly begin to be seriously affected. Dispersal of the pathogen by flood water is not involved, and so far the nature of the factor which is operative has not been ascertained. An increase in the pathogen population doubtless bears a direct relation to the increasing incidence of the disease, but relevant data are scanty or absent.

On the controversial question as to whether fresh outbreaks are principally due to contact with neighbouring diseased plants or are the result of new sporadic infections, little can be added save that numerous instances of both abound in those areas where the disease is making headway. It has been observed that spread by contact takes place more rapidly in some soils than in others: the more open the texture and the more acid the soil, the more rapid is the spread of disease. Alternatively, clay soils and slightly alkaline soils appear to possess more 'resistance' to the disease. This information has now been available for some years[1], and recent observations would seem to bear it out. On light riverside soils, for example, the spread of disease from foci of infection may be particularly rapid. Recent years have also shown that clay soils, for many years considered 'resistant', have eventually shown an even more rapid spread—a phenomenon for which no adequate explanation has so far been forthcoming. Other areas are also known which, after many years in an almost disease-free state, are now becoming rapidly affected. The collective experience, practical and scientific, in Central America is that hydrogen ion concentration is the master factor determining the severity of Panama disease, followed by texture; but, as Reinking's work shows, distribution of the pathogen and density of its population in the soil obviously require careful consideration[2].

The Panama disease situation in Central America is being closely watched, and on the properties of the larger companies every effort is being made to check its spread and to test out any new idea which might eventually have some economic value. An unusually interesting and important experiment is in progress at the present time. This consists in flood-fallowing an area of about a hundred acres which had previously been put out of production by Panama disease. The area has been empoldered and divided into four sections, each to be kept submerged for a different period of time. The maximum period of inundation will be eighteen months. This experiment is based on the facts that soil fungi such as *Fusarium cubense* require oxygen to live, and that, when highly infected soil was submerged for one month under two feet of water, no *F. cubense* could be found in it. The outcome of this experiment will be awaited with the greatest interest by all associated with the extensive alluvial banana lands of Central America. Already it has been found that in new land, built up by the sedimentation of controlled flood water, and therefore subjected to several inundations, the incidence of Panama disease has been negligible. This may be considered as an indication of the probable success of flood-fallowing, but time alone will tell. A successful result will obviously have an important bearing on the whole question of banana production in the Caribbean.

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[1] Wardlaw, "Diseases of the Banana", Chap. iii. Macmillan (1935).

[2] Reinking. Several papers summarized in (1) above.

OBITUARIES

Prof. G. Dawes Hicks, F.B.A.

THE loss of Prof. G. Dawes Hicks, on February 16, at the age of seventy-eight, will be felt, not only by the wide circle of his personal acquaintance, but also by all who have at heart the interest of philosophy in Great Britain. Friends and students will cherish the memory of his kindly and affectionate nature, his simplicity of heart, his unfailing courtesy, the generous hospitality of his house and table, and his readiness to place his store of learning and the rich resources of his library at the disposal of all students of the problems that engrossed his life. They will not easily forget the short spare figure of the teacher whose frail appearance veiled an iron constitution, that enabled him to excel as a climber and to carry out the duties of his London chair from his house in Cambridge with unabated efficiency. He was professor of philosophy in University College, London, during 1904–28, and lectured on psychology at Cambridge regularly. His energy both of body and mind was amazing. Even when stricken with illness and the sorrow of his wife's death his high courage never failed him; in his last three years he published his Hibbert Lectures on the "Philosophical Basis of Theism" and a volume of noteworthy essays, and persisted in his work as sub-editor of the *Hibbert Journal* from his sick-bed to the very end. He had been largely responsible for founding the *Journal* in 1901–2.

Hicks loved philosophical discussion, whether by his own fireside or at public gatherings, such as those of the Aristotelian Society and the Mind Association. He was secretary of the Aristotelian Society for many years, and its president in 1913. When he spoke it was with lucidity and precision, voicing definite convictions uncompromisingly but with singular modesty. No one could fail to be impressed by his fairness in controversy, his intellectual integrity, and the distinction of mind that lay behind his quiet measured utterances. It was the same with his writings. Disdaining all artifices of style or appeals for popularity, he wrote as a philosopher for fellow-philosophers, so that his books were scarcely calculated to rouse attention outside the academic boundary. They were caviare to the general; though his study of Berkeley, in the "Leaders of Philosophy" series, forms the best introduction to that thinker in the language, and the addresses delivered annually as a labour of love at the Carmarthen College, published in 1928 under the title "Ways towards the Spiritual Life", have a charm that goes straight to the reader's heart. It can truly be said of him that he wrote nothing that does not repay the reading.

Hicks was before all things a critical thinker, in the true Kantian sense; throughout his life he kept himself pure from the extremes either of scepticism or of dogmatism. He was very learned, recalling in his chosen way of life the *Gelehrter* of a now almost forgotten Germany rather than the normal type (if such there be) of an English university professor. But for all his scholarship he remained master of his own mind, and his thought was always on the move. To the end he was faithful to the example of his first great teacher, Robert Adamson. His studies at

Oxford and in Germany led him by way of Neo-Kantism to an idealist position akin to that of Bradley, and thence to the *via media* on which he took a firm stand during the last twenty years of his life, and to which he gave the appropriate name of 'Critical Realism'. The problems that most engaged his mind were in the fields of theory of knowledge and the philosophy of religion. His realism, evidenced in the refusal to allow any "bifurcation of Nature", was, in many respects, akin to that of Whitehead. Why, he kept asking, should not the grass be really green? He contended resolutely against the naturalistic fallacy of treating the knowing subject as an object among other objects. Perhaps his most characteristic doctrine was the threefold distinction that he discerned, alike in perceptual and conceptual thinking, between the activity of apprehension, the content apprehended, and the apprehended object; a distinction by which he endeavoured, in a manner reminiscent of the scholastic distinction of the *id quod concipitur* (the object) from the *id quo concipitur* (the concept), to escape both the Scylla of naïve realism and the Charybdis of representative perception.

In religion Hicks was all his life a member of the Unitarian communion, in which he had in earlier years exercised the ministry, from 1897 until 1903, at Unity Church, Islington. In his Hibbert Lectures he set himself to expound the rational grounds for his strong theistic faith. The strength of the book lies in its massive presentation of the cosmological, teleological, and moral arguments as a correlated sequence of evidence to a God, who is at once distinguishable from the Absolute of monistic idealism and subject, on epistemological grounds to temporal succession. The weakness lies in the author's evident lack of sympathy with any form of mysticism and in his disparagement of the evidence from religious experience. The thought of man's relation to God as that of a subject to a *subject* seems scarcely to have crossed his mind.

That Hicks left no finished system of philosophy was doubtless due in part to his lack of speculative imagination. He cannot be ranked with thinkers like Bradley, Alexander or Dr. Whitehead. But he threw much light—a dry light, as befits a philosopher —on many of the most important problems of modern thought. In early days, for example, he had studied psychology and psycho-physics under Wundt, Heinze, Volkelt and Hering, an interest that was fortified and deepened later through his friendship with James Ward. A striking essay on "The Dynamic Aspect of Nature" and another in criticism of Sir Arthur Eddington testify to his grasp of recent developments in physics. He gradually came to be recognized as one of the most competent and judicious thinkers of his generation; his old University of Manchester conferred on him a doctorate, and in 1927 he was elected a fellow of the British Academy. He will be long remembered with honour as a great scholar and teacher, a disinterested inquirer after speculative truth, and one of the most lovable of men.

W. G. de Burgh.

Prof. C. R. Lanman

We regret to record the death of Prof. C. R. Lanman, the distinguished authority on the ancient languages and culture of India, emeritus professor of Sanskrit in Harvard University, which took place at Boston on February 20 at the age of ninety.

Charles Rockwell Lanman was born at Norwich, Connecticut, on July 8, 1850. He graduated at Yale in 1871 and was awarded his Ph.D. in 1873 for his studies in Greek and Sanskrit. Further studies of Sanskrit and comparative philology followed during a period of four years spent at Berlin and Tübingen, where he was a student under the most distinguished authorities in these subjects of the day, among them Roth and Curtius. During 1876–80 he held an appointment as lecturer on Sanskrit at Johns Hopkins University, Baltimore, and was then elected to the chair of Sanskrit in Harvard University, which he occupied for fifty-six years. During his tenure, in 1889, he travelled extensively in India with the object of securing books in his subject for the library of his University. His tour was highly successful, the accessions he acquired numbering some thousand items including both books and manuscripts. In 1890 he delivered the Percy Trumbull Lectures at Johns Hopkins, his subject being Indian poetry, and lectured at the Lowell Institute, Boston, on Indian literature and early history.

Lanman was a fellow of the American Academy of Arts and Sciences and edited the *Transactions of the American Philological Association*, of which he was secretary and in 1890 president. He also edited the publications of the American Oriental Society for some years, serving successively as its corresponding secretary, vice-president and president, holding the latter office on two occasions, in 1907 and 1919.

In addition to his editorial activities, Lanman himself published a number of works on Sanskrit, including "Hindu Drama" (1900) and "The Beginnings of Hindu Pantheism" (1890). He was also responsible, in association with the leading Orientalists of the whole world, for the Harvard Oriental series, of which forty volumes have been published, containing editions of most of the classics of the ancient East. Among the numerous honours he received in recognition of his eminence in Oriental studies, was a gold medal on the occasion of the celebration in Japan of the 2,500th anniversary of the birth of the Buddha. He was a corresponding member of the British Academy.

We regret to announce the following deaths:

Dr. C. R. M. F. Cruttwell, principal of Hertford College, Oxford, during 1930–39, on March 14, aged fifty-three.

Mr. J. P. Gilmour, editor of the *Pharmaceutical Journal* during 1916–33, on March 10, aged eighty.

Dr. E. L. Ince, lecturer in technical mathematics, University of Edinburgh, on March 16, aged forty-nine.

Prof. Mary S. Rose, professor of nutrition in Teachers College, Columbia University, on February 1, aged sixty-six.

NEW FELLOWS OF THE ROYAL SOCIETY

At the meeting of the Royal Society on March 20, the following new fellows were elected:

Prof. W. N. Benson, professor of geology, University of Otago, Dunedin, New Zealand; distinguished for his contributions to the geology, petrology and physiography of Australia and New Zealand and in particular for his studies on the ultra-basic igneous rocks.

Dr. H. J. Bhabha, Reader in theoretical physics, Indian Institute of Science, Bangalore; distinguished for his contributions to the understanding of cosmic ray phenomena, and to the fundamental theory of the elementary atomic particles.

Dr. E. C. Bullard, Smithson research fellow of the Royal Society; distinguished for his work in geophysics and for the light which his work has thrown on the structure of the Great Rift Valley and on the rock floor deep under the surface in England and the surrounding seas.

Dr. C. D. Darlington, director of the John Innes Horticultural Institution, Merton, London, S.W.19; distinguished for his researches in cytology and cytogenetics.

Mr. P. I. Dee, university lecturer in physics, Cambridge; distinguished for his experimental work in nuclear physics, in particular on atomic nuclear transformations produced artificially under bombardment by high-speed protons or deuterons.

Surgeon Rear-Admiral S. F. Dudley, C.B., O.B.E., medical director-general of the Navy (designate); medical officer in charge R.N. Hospital, Chatham; formerly director of medical studies to the Royal Navy: distinguished for his work in epidemiology and bacteriology, especially in relation to the spread of diphtheria, influenza and meningitis.

Dr. J. C. Eccles, director of the Kanematsu Memorial Institute for Pathology in Sydney, formerly Rhodes scholar (Australia) and fellow of Magdalen College, Oxford; distinguished for his physiological researches, which have dealt principally with excitation and transmission in the neuromuscular system.

Prof. H. W. Florey, professor of pathology in the University of Oxford, formerly Rhodes scholar (Australia), fellow of Gonville and Caius College, Cambridge, and professor of pathology, Sheffield; distinguished for his work in general pathology, in particular on lacteals and lymphatics and on Brunner's glands. His work on 'lysozyme' has led to its isolation in a pure form.

Mr. A. A. Griffith, research engineer, Rolls-Royce Ltd., formerly Royal Aircraft Establishment, Farnborough; distinguished for researches, ranging from pure physics to applied engineering, which have made notable contributions to the knowledge of strength of materials and to the science and development of aircraft and aero-engines.

Prof. H. W. Melville, professor of chemistry in the University of Aberdeen, formerly fellow of Trinity College, Cambridge; distinguished for his outstanding contributions in the study of gaseous reactions and of the mechanism of polymerization.

Dr. J. Needham, reader in biochemistry in the University of Cambridge, and fellow of Gonville and Caius College; distinguished for his application of biochemical methods to embryology, particularly in relation to the conditions determining embryonic and adult metabolism, and vertebrate development.

Sir David Rivett, deputy chairman and chief executive officer of the Australian Council for Scientific and Industrial Research, formerly Rhodes scholar (Australia) and professor of chemistry in the University of Melbourne. His scientific knowledge and leadership have been of great value to the Australian Commonwealth and the Empire.

Prof. Alexander Robertson, professor of organic chemistry in the University of Liverpool; distinguished for his researches on the constitution of plant products, and particularly on the important insecticide rotenone.

Prof. T. G. Room, professor of mathematics in the University of Sydney; distinguished for his work in geometry.

Mr. A. J. Rowledge, consultant engineer to Rolls-Royce, Ltd., formerly chief designer, D. Napier and Sons, Ltd.; distinguished for innovations in the design and development of internal combustion engines for motor-vehicles and aircraft.

Dr. H. Scott, assistant keeper of entomology in the British Museum (Natural History); distinguished as a field naturalist and systematist. By prolonged visits to the Seychelles, Abyssinia and South Arabia, he has greatly advanced our knowledge of the little known and fast disappearing or changing fauna of these areas.

Dr. F. E. Simon, reader in thermodynamics in the University of Oxford; distinguished for the development of new methods of liquefying helium and for his studies of phenomena at the lowest temperatures yet attained.

Dr. H. G. Thornton, head of the Bacteriology Department, Rothamsted Experimental Station; distinguished for his investigations in soil bacteriology and on the relations existing between nodule-forming bacteria and their leguminous hosts.

Mr. R. A. Watson Watt, scientific adviser on telecommunications, Ministry of Aircraft Production, formerly superintendent, Radio Department, National Physical Laboratory; distinguished for his contributions to radio engineering, particularly in relation to aerial and marine navigation.

Mr. P. Bruce White, member of the scientific staff of the National Institute for Medical Research, Hampstead; distinguished for his fundamental studies of bacterial immunology, in particular of the antigenic constituents of members of the Salmonella group.

NEWS AND VIEWS

H. E. Armstrong Lecture

ALTHOUGH H. E. Armstrong did not take an active part in the formation of the Society of Chemical Industry, he was nevertheless one of the original members, and the Society has founded a Lecture in his memory. The task of delivering the first of what will no doubt be a series of distinguished lectures, was a difficult one, and the Society could not have selected a better man than the son of 'H. E. A.' Dr. E. F. Armstrong and his father had many interests in common; they followed the same profession, they took holidays together, and, Dr. Armstrong says, he was "closest to him over nearly sixty years", being in almost daily contact with him by letter even when separated geographically. Now Dr. Armstrong has given an intimate account of his father's life and work in the form of the first Armstrong Lecture, which was delivered on February 3. The complete Lecture has been published in *Chemistry and Industry* (Feb. 8). Some of the ground covered, particularly that relating to chemical work, was dealt with by "W. P. W." in the obituary notice which appeared in NATURE of July 24, 1937. The last part of Dr. Armstrong's lecture, however, reflected more of the personal and human aspects of the 'H. E. A.' known to the present generation of men of science, and it seemed appropriate that this portion, supplementing in some ways the obituary notice, should appear in NATURE (see p. 373), where many of Armstrong's stimulating and often provocative contributions were published.

Scientific Co-operation between Great Britain and the United States

ON March 20, the president and council of the Royal Society entertained fellows of the Society and a number of friends at a buffet luncheon at Burlington House to meet Dr. J. B. Conant, the president of Harvard University. Sir Henry Dale and Dr. Conant received the guests, who numbered more than a hundred and fifty, among whom were Sir John Anderson, Lord Hankey, the High Commissioners for Australia, Canada and South Africa, and five of Dr. Conant's colleagues in his mission, namely Dr. K. T. Bainbridge, Dr. F. L. Hovde, Dr. E. J. Poitras, Dr. Warren Weaver and Dr. Carroll L. Wilson. At the conclusion of the luncheon, in the Society's meeting room, Dr. Conant gave a brief talk. He expressed his great pleasure at meeting such a representative body of British men of science, and hoped that his visit to this country would further the co-operation between scientific workers on both sides of the Atlantic, particularly in the direction of an interchange of ideas and experiences bearing on problems arising out of the War.

Emergency Scientific Research Bureau in Eire

THE Government of Eire has set up a small advisory body, to be known as the Emergency Scientific Research Bureau, to deal primarily with the technical problems involved in the provision of substitute processes and materials during the period of the emergency. This body, which will be attached to the Department of the Taoiseach, has the following terms of reference: (1) To give technical advice to the Government on such special problems relating to industrial processes and the use of substitute materials as may be referred to them. (2) To advise the Government generally on the use of native or other materials to meet deficiencies caused by the restriction of imported raw materials and commodities. (3) To direct or conduct special researches and inquiries connected with the above.

The following have been appointed to be members of the Bureau: Prof. J. J. Dowling (chairman), professor of technical physics, University College, Dublin; Dr. J. J. Drumm; Prof. M. A. Hogan, professor of mechanical engineering, University College, Dublin; Prof. J. H. J. Poole, professor of geophysics and experimental physics, Trinity College, Dublin; Dr. T. S. Wheeler, State chemist. The secretary to the Industrial Research Council, Dr. J. J. Lennon, will act as secretary to the Bureau. The Bureau will utilize the premises of the Industrial Research Council, 45 St. Stephen's Green, Dublin.

University College, Cardiff: Air Raid Damage

UNIVERSITY College, Cardiff, has suffered to some extent in recent air raids, the most extensive damage being at the Students' Union building. The refectory of the Union, which was erected with money collected by students as a memorial to those students who lost their lives in the War of 1914–18, has been wrecked, and will probably have to be rebuilt, while the rest of the Union premises have also been badly shaken. Fortunately the new gymnasium, recently completed at a cost of £17,000, escaped almost untouched. The Cathays Park buildings of the College suffered from blast, many windows and almost all the roof lights being destroyed. The Tatem Laboratories were the most affected, and blast caused a considerable amount of damage internally to fittings and apparatus in both the Physics and the Chemistry Departments, though not enough to put these Departments out of commission for more than a few days. A fire was started in the Drapers' Library but was quickly extinguished by the fire watchers. Fire watchers at the Union luckily escaped serious injury, but one of the watchers in the College buildings has unhappily died of injuries received in the course of his duties. A young assistant on the staff of one of the visiting institutions which are at present working in University College, Cardiff, was also killed at his lodgings in the town. These casualties have caused deep regret.

Cost of Living for Working-Class Families

A FURTHER publication in the New Merseyside Series issued by the Statistics Division of the Social Science Department, University of Liverpool, deals with the cost of living of representative working-class families (Liverpool: University Press. London: Hodder and Stoughton, Ltd. 1*s*.). A household consisting of father, mother and young children has been selected as representative, as well as a widow supporting two children of school age, and a husband and wife, both old-age pensioners. Essential needs are sub-divided under the usual five heads: food, clothing, rent and rates, fuel and light, sundries. In regard to food, the findings of the report of the British Medical Association Committee on Nutrition have been taken as one basis, but the specimen diets were modified to satisfy rationing regulations and to permit greater variety in diet and elasticity in cooking. The poverty standard selected is that adopted for the Merseyside Survey. The report indicates that between June 1933 and October 1940, expenditures showed increases of 57·5 per cent, 64 per cent and 76 per cent respectively for the family, widow with children, and old-age pensioners.

Comparing the estimated basic needs of these representative families, poverty standards, actual expenditure, and income from the social services, the inquiry indicates that the services concerned succeed in finding a close approximation to the cost of bare subsistence, though this is appreciably below the human needs standard. The blot on the social services is the absence of adequate provision of assistance for sick persons and their families, and the reduction in benefit when work is lost on account of illness. The report includes an analysis of actual expenditure of three typical non-earning families as well as of the average expenditure of 8,905 families, and a comparison with human needs, which suggests that the British Medical Association diets are what they were intended to be, estimates of the *minimum* expenditure on food necessary for health and working capacity. The sums spent on rent, fuel and light in the average budget are also rather higher than those allotted on the human needs standard, but the difference between the two results under the head of clothing is insignificant. The total average household expenditure revealed in the budgets collected by the Ministry of Labour is 50 per cent higher than the estimated cost of living at the human needs level.

Hindu Iconography

A VALUABLE collection of paintings and bronzes of international repute illustrating Indian art and religion has recently been added to the national collections by donation to the Department of Oriental Antiquities of the British Museum (Bloomsbury). It has been given by Mrs. E. C. Moor and was formed by her husband's grandfather, Major Edward Moor, F.R.S. (1771–1848), while gathering material for his pioneer work "The Hindu Pantheon" (1810). The collection consists of 609 objects, of which 360 are bronzes and 249 are paintings and drawings. The paintings, which with the bronzes were for the most part acquired through a pandit of Poona, to whom Moor refers and who identified the subjects, are Decani in style. Some belong to an eighteenth century Rajput school, while the most important illustrate verses by the poet Keśava Das of Bundelkund (1555–1617) and were probably executed at Jaipur in the early eighteenth century. The majority of the bronzes are of seventeenth century or eighteenth century date. The value of the collection lies in its original purpose as illustrating Hindu iconography; and as is pointed out in an account of the collection (*Brit. Mus. Quarterly*, 14, 4; 1940), since not all of them were used in "The Hindu Pantheon" and those that were engraved for publication were "made more handsome", there is room for much fresh work on the collection. It is hoped that it will provide the nucleus of a study collection for students of Indian art and religion.

Birds of North-West England

A LIST of 270 species and five subspecies together with much original information on bird habits and movements resulting from some twenty years field-study of bird life in the area between the Ribble and the Dee and inland to Warrington were given on February 13 in a paper to the Liverpool University Biological Society by Mr. Eric Hardy, an honorary member, who reviewed the results as they had been drawn up for the Merseyside Naturalists' Association's proposed handbook on the birds of the area. Much of this work might seem idle in war-time, but the bird census and survey have disclosed items of economic importance such as the distribution and habits of useful and harmful birds on the land, which are being sent to the Royal Lancashire Agricultural Society. The increase in the distribution of wild duck, waders, gulls, crows, owls, etc., and the decrease of other birds is of more than natural history interest.

The bird census showed an average density of 6·7 birds to the acre; the house-sparrow, which forms 38 per cent of the bird population of a Liverpool suburban park, forms only 2 per cent of the population of rural Knowsley Park. Mr. Hardy pointed out that a knowledge of the economic position of bird life in an area is essential to war-time agricultural efforts in order to know what to protect and what to repress—an undertaking too often treated from a national rather than a local attitude. It has often been stated that we could not live more than nine years without birds owing to the ravages of insect pests they control; but modern field work has shown that a greater toll of insect pests like caterpillars is taken by predatory insects.

Spike Disease of Sandal

THE spike disease of sandal was first noticed forty years ago and since then numerous investigators have studied the problem. For the most recent account of the disease the reader is referred to an article by Rao Sahib S. R. Iyengar and A. L. Griffith (*Indian Forest Records*, 6, No. 4). Work so far carried out has led to the conclusion that it is an insect-borne disease. The vector is of such a size that it can pass through a mesh of $\frac{1}{4}$ in. but is excluded by one of $\frac{1}{20}$ in. The average period from infection to manifestation of the disease is approximately 7 months in the case of natural infection and $4\frac{1}{2}$ months with artificial infection. From manifestation of the disease until death of the tree, the average period is about 15 months but varies with the girth of the tree. The transmission of the disease to healthy trees by grafting can be carried out most easily by a semi-trained staff, by leaf-grafting. Successful transmission by means of any particular insect has not so far been carried out, but suspicious spike-like symptoms have appeared in seven cases. Grafting, however, failed to transmit these same symptoms to healthy plants. While the vector is as yet unknown, the available evidence points to its being an uncommon species of insect of the order Hemiptera.

Science Masters' Association

It is satisfactory to learn from the report of the Science Masters' Association for 1940 that the membership remains almost stationary and that the schools represented, now more than 950, show a slight increase. It is suggested that meetings of the eight branches of the Association, which were discontinued last year, should be started again in spite of difficulties, and that the Examinations' Sub-Committee might receive more criticisms from members. This work is most useful, and every effort should be made to keep it up.

Motor-Vehicle Industry in Great Britain

According to an article in *Engineering* of January 31, new registrations of private cars in Great Britain in the first seven months of 1940 totalled only 30,200, compared with 194,500 in 1939. Since July 1940, new registrations have been taken out at the rate of only 200–300 a month. New registrations of commercial vehicles up to July were about one quarter of the corresponding figures for 1939; after July, however, there was a fall from an average of about 1,400 a month to about 300 a month as the result of the ban on sales except by special permit. Exports of private cars from the United Kingdom in 1931 numbered 17,104; in 1937 the figure was 53,655; and in 1939 it was 35,190 during January–August and only 8,040 during September–December. These figures show that the rate of export of complete cars and chassis was approximately halved as the result of the outbreak of war. A comparison of British exports and new registrations during the early months of 1940 suggests that the production of private cars was probably at the rate of 6,000 a month. This compares with about 30,000 a month during the early months of 1939 and a peak production of more than 32,000 a month in 1937. The production of private cars for the home market had thus become only a subsidiary function of the industry, the main functions of which were the provision of trucks and lorries for the Army and assistance to the aircraft industry.

On the retail side, the reduction in the sales of new vehicles has resulted in an appreciable fall in turnover of most of the firms in the industry, though this fall has probably been very much less than was anticipated at first. During the winter of 1939–40, about half a million motor-cars were laid up—approximately a quarter of the total number in use. Many of these were put back on the road in the spring. For the quarter ended June 30, 1940, receipts from motor-vehicle taxes were £850,000 higher than for the corresponding quarter of 1939. This must be considered very satisfactory, especially in view of the increased rate of tax. Motor-cycles were excluded from the ban on sales of motor-vehicles imposed in July. Up to August 1940, home sales were at the rate of about 3,000 a month, compared with rather more than 5,000 in the preceding year. A significant feature of the sales during 1940 was the high proportion of the total accounted for by motor-cycles of less than 150 c.c. capacity. These have consistently accounted for between 70 and 80 per cent of the total sales, whereas for 1939, the corresponding proportion was only about 25 per cent. It is to be hoped that the impetus given by petrol rationing to the development of the small machine in Great Britain will encourage British exporters to meet foreign competition at the end of the War.

Diesel-Engine Driven Generating Station

A new electric-generating station has been installed at Port Macquarie, which is a seaside town at the mouth of the Hastings River, New South Wales. The power is supplied by three Diesel engines furnished by Messrs. Blackstone and Co., Ltd., Stamford, Lincs, directly coupled to alternators having a combined output of 500 kilowatts. Two of the engines are 240 b.h.p., six-cylinder units, and the third is a 120 b.h.p. three-cylinder engine. The engines are of the latest totally enclosed design, and as the plant has to run unattended for part of the day, an alarm signal has been installed, which is claimed to give complete protection against accidents, such as an excessive rise in the lubricating oil temperature, failure of the cooling-water flow, overspeed or overloading, failure of the oil pressure or excessive temperature of the cooling water. If the alarm is not attended to within five minutes, the engine automatically stops and no damage is done. The engine room measures 70 ft. by 31 ft., and a special fuel room is provided, the fuel entering the engine room through a trench, which also accommodates the air, lubricating oil, and cooling-water pipes.

Comets

Comet Friend-Reese. Harvard Card 560 announces that Mr. Clarence L. Friend, Escondido, California, discovered a comet on January 17. It was discovered independently by Mr. E. J. Reese, Uniontown, Pennsylvania, and was described as diffuse with a nucleus, tail less than 1° in length, magnitude 10. Messrs. K. Guthe and R. M. Thomas of the Harvard Observatory have determined a position of the comet from a pre-discovery image on a Harvard plate taken with the *FA* camera (Cambridge, 1·5 in. aperture), and from a plate taken with the *I* camera (Cambridge, 8-in. aperture). The first was on Jan. 0·9908 and the other on Jan. 29·00698, and from these and an observation on January 19 they have computed the following orbit :

T	1941 Jan. 20·633 U.T.	
ω	132° 35·9′	1941·0
Ω	329 2·9	
i	26 36·5	
q	0·94285	

Comet Encke. Harvard Card 561 announces that Van Biesbroeck, Yerkes Observatory, reports the discovery of this comet on Jan. 19·033. It is described as diffuse with a nucleus, the magnitude being 17. In the "Handbook of the British Astronomical Association, 1941", the late Dr. A. C. D. Crommelin gave the elements and an ephemeris, and the comet is very close to the predicted position.

Comet Paraskevopoulos (1941 *c*). This comet was discovered by Dr. John S. Paraskevopoulos, of the Boyden Station, Bloemfontein, on January 23, and also by Dr. R. Grandon and others. Its magnitude was stated to be 3·5 and its tail was 5° in length. An orbit computed by Wood and Jackson, and cabled by Dr. John Jackson, Cape of Good Hope, is given below, and also an ephemeris :

T	1941 Jan. 27·779 U.T.	
ω	268° 26′	1941·0
Ω	41 50	
i	168 08	
q	0·7894	

1941	R.A.	Dec.	ϱ	r
March 27	2h 08m	+11·3°	2·124	1·327
31	2 10	11·8		
April 4	2 11	12·3	2·323	1·435
8	2 13	12·7		
12	2 14	13·1	2·497	1·544

Comet Okabayasi – Honda (1940 *e*). This comet was discovered at Tokyo on October 4 and was described as being of magnitude 11 and possessing a nucleus. The elements of an orbit and also an ephemeris, computed by Miss E. L. Scott and Mr. H. A. Panofsky, of the University of California, are given below :

T	1940 Aug. 15·8440 U.T.	
ω	329° 50′ 16″	1940·0
Ω	127 15 15	
i	133 07 30	
q	1·06372	
e	1·00345	

1941	R.A.	Dec.	ϱ	r
March 27	1h 10·6m	48° 52′	3·903	3·314
April 4	1 17·3	49 03		
12	1 23·8	49 22	4·185	3·490
20	1 30·2	49 49		
28	1 36·0	50 22	4·410	3·663

The Night Sky in April

THE moon is full on April 11 at 21h. and new on April 26 at 13h. U.T. A naked-eye star, ο Leonis (mag. 3·8) is occulted on April 7, the disappearance, as seen from Greenwich, taking place at 21h. 43·5m. at position angle 58° from the north point of the moon's image. Jupiter and its companion, Saturn, are planets of the evening sky. Both will soon be too close to the sun for observation, but they will re-emerge as morning stars towards the end of June. Mars continues as a morning star, and is 5° above the eastern horizon about 3h. 30m. U.T. in mid-April. The distant planet, Neptune, is not far from β Virginis and comes to the southern meridian shortly after 22h. U.T. in mid-April (add 1 h. to convert to Summer Time). This planet, seen as a star of magnitude 8, requires for its detection some telescopic aid and a section of a star map for guidance such as is given in the "Handbook of the British Astronomical Association, 1941", p. 9. In the same constellation is one of the best-known binary stars, γ Virginis. The components are of nearly equal magnitude (3·6 and 3·7 respectively) and their present separation is 5¾″; the period is about 180 years. The Lyrid meteors are most frequent about April 20, their radiant point being near 104 Herculis, that is, south-preceding the bright star, Vega.

Announcements

DR. F. C. HAPPOLD, lecturer in biochemistry in the University of Leeds, has been elected to the recently instituted readership in biochemistry.

THE Herbert Jackson Prize of the London, Midland and Scottish Railway for 1940 has been awarded to Mr. S. C. Britton, of the Metallurgical Department (Engineering Section), Derby, for his paper entitled "The Corrosion of Copper and some Copper Alloys in Atmospheres highly polluted with Coal Smoke".

THE Chemical Society will attain its centenary on March 30, and will hold the hundredth annual general meeting at Burlington House on Thursday, April 3. The business portion of the meeting will be at 12 noon when the election of Prof. J. C. Philip as president, and of those fellows nominated to fill vacancies among elected ordinary members of Council will be announced. At 2.45 Sir Robert Robinson, the retiring president, will deliver his presidential address entitled "The Mechanism of the Benzidine Rearrangement and some Related Topics". Arrangements for the celebration of the centenary of the Society have been postponed until after the War.

AT the annual general meeting of the Royal Astronomical Society held on March 14, the following officers were elected for the ensuing year : *President*, Prof. S. Chapman ; *Vice-Presidents*, Prof. David Brunt, Sir James Jeans, the Rev. T. E. R. Phillips, Prof. H. C. Plummer ; *Treasurer*, Mr. J. H. Reynolds ; *Secretaries*, Mr. D. H. Sadler, Dr. A. D. Thackeray ; *Foreign Secretary*, Sir Arthur Eddington.

THE publication "Rubber and its many Uses", by H. McKay, in "The Empire at Work" series (Oxford University Press, 1940) deals, in 76 pages, and in very simple language with the production of rubber in the plantation and the way in which it is manufactured into various articles such as sponges, tubes, tyres, tennis and golf balls, and hard rubber. The whole is well illustrated. The price is 10*d*.

LETTERS TO THE EDITORS

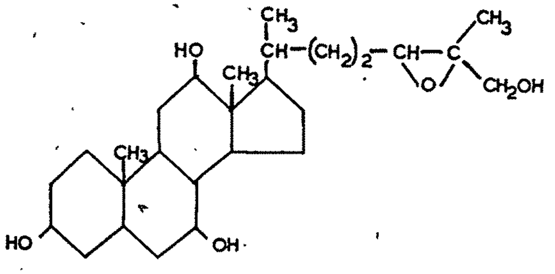
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Bile Acids of Elasmobranch Fish

THE bile of bony fishes, like that of birds and mammals, contains acids in which glycine or taurine is conjugated with mono-, di-, and tri-hydroxy derivatives of cholanic acid. On the other hand, Hammarsten[1] isolated from the bile of the shark, *Scymnus borealis*, acids which he showed to be sulphuric esters of neutral compounds, chiefly α-scymnol. The constitution of scymnol has been largely elucidated by the investigations of Windaus, Bergmann and König[2], and of Tschesche[3], who have shown that the compound is related to the commoner bile acids, but contains eight carbon atoms in the side chain like cholesterol, whereas the usual bile acids contain only five. This has considerable bearing on the view that the bile acids arise from the degradation of cholesterol, and it has been suggested[2] that the shark, which belongs to a primitive order of fish, lacks the ability to effect more extensive oxidation of cholesterol to the bile acids. This is evidently not entirely true, for Ota[4] has recently isolated cholic acid as well as scymnol from the bile of a species of shark found in Japanese waters.

The correspondence in positions and configurations of the nuclear hydroxyl groups of scymnol and cholic acid has been established by Ashikari[5] who degraded scymnol to cholic acid. The following is accordingly the structure of scymnol, the evidence for the ethylene oxide ring being somewhat inconclusive.



The scymnol used by Ashikari was isolated from the bile of *Dasyatis akajei*, a species of sting ray found in Japanese waters. An examination has now been made of the bile of the blue skate, *Raia batis*, and the grey dogfish, *Squalus acanthias*, caught off the Faroes during the summer and autumn. Immediately after the fish were killed the gall bladders were squeezed into a large excess of absolute alcohol, and the alcoholic bile was afterwards worked up as described by Windaus *et al.*[2] Pure scymnol, m.p. 192–193° (corr.) was readily isolated in considerable quantity, from the bile of both of these cartilaginous fish. It had $[\alpha]_D^{18°} = + 39{\cdot}4°$ ($c = 2{\cdot}614$ in alcohol, (found: C, 72·1; H, 10·1. calc. for $C_{27}H_{46}O_5$, C, 71·9; H, 10·3 per cent). There were minor amounts of resinous bile acids from which a pure component has not yet been isolated. Alkaline hydrolysis of the bile from the teleostean angler fish (*Lophius piscatorius*) gave no water-insoluble product so that scymnol-sulphuric acid was not present. Scymnol, esterified with sulphuric acid, thus appears to be a characteristic major component of the bile of elasmobranch fish.

The scymnol obtained from the skate bile was further characterized by conversion into the dihydrate[6], the hydrochloride[2], and the tetra-acetyl derivative[3] (this was prepared by Dr. J. D. Loudon). In preliminary experiments on the isolation from both skate bile and dogfish bile complications arose from the fact that purification of the crude dihydrate by crystallization from ethyl acetate gave a product which formed colourless slender needles, m.p. 138–140°. This evidently still contained water of crystallization. (Found: C, 70·7; H, 10·4. $C_{27}H_{46}O_5,\frac{1}{2}H_2O$ requires C, 70·5; 10·3 per cent.) Its formation was apparently associated with the quality of the ethyl acetate, for it was rapidly and completely transformed into anhydrous scymnol when warmed with pure ethyl acetate obtained from another source.

This investigation, which is being continued, was made possible by the co-operation of Dr. J. A. Lovern, of the Torry Research Station, Aberdeen (Department of Scientific and Industrial Research) who kindly arranged for the collection of the bile.

J. W. COOK.

Chemistry Department,
University of Glasgow.
Feb. 22.

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[1] Hammarsten, O., *Z. physiol. Chem.*, 24, 322 (1898).

[2] Windaus, A., Bergmann, W., and König, G., *Z. physiol. Chem.*, 189, 148 (1930).

[3] Tschesche, R., *Z. physiol. Chem.*, 203, 263 (1931).

[4] Ota, K., *J. Biochem.* (Japan), 29, 241 (1939).

[5] Ashikari, H., *J. Biochem.* (Japan), p. 319.

[6] Compare Oikawa, S., *J. Biochem.* (Japan), 5, 63 (1925).

Insect Cuticle as an Asymmetrical Membrane

IN a recent communication[1], I provided evidence to show that the permeability of the outer 'lipoid layer' of insect cuticle to feebly dissociating substances of high dielectric constant may be greatly increased by relatively apolar substances of low dielectric constant. Since then I have obtained similar results for the outer cutinized layers of a number of plant epidermal membranes. The physical and chemical properties of plant 'cutin' are said to resemble those of the insect 'epicuticle' or 'lipoid layer'[2], and this suggested that induced penetration of polar substances was not a fundamental characteristic of insect cuticle, but might take place with relatively simpler artificial membranes.

The permeability of thin rubber membranes was found to be similar to that of insect 'epicuticle' or plant 'cutin'. Rubber swells readily in oils of low dielectric constant such as kerosene, but imbibes relatively small proportions of oils of higher dielectric constant such as oleic acid or castor oil. Rubber membranes are only slightly permeable to ethyl alcohol, but the presence of kerosene in the disperse phase of the membrane framework increases the permeability of the membrane to ethyl alcohol, which is miscible with kerosene. This effect is negligible with oleic acid or castor oil.

Similar considerations apply to other membrane systems. Collodion imbibes 'gelifying liquids' such as ethyl or propyl alcohols, whereas kerosene is less readily imbibed and will precipitate collodion from solution in a mixture of ethyl alcohol and ether. 'Cellophane' and parchment membranes imbibe water more readily than ethyl alcohol or kerosene. As with collodion, the permeability of such membranes to ethyl alcohol is not increased by oils of the kerosene type. These observations stress the importance of the physico-chemical relation between a membrane and permeating substance in determining whether the permeability of the membrane to this particular substance might be modified by the introduction of other components into the system. Generally, it would appear that the permeability of apolar hydrofuge membranes to relatively polar substances is increased by substances of intermediate polarity which are more readily imbibed by the membranes. The degrees of induced penetration will depend partly on the mutual solubilities of the mixture of permeating substances, and partly on the rates at which the polar substances diffuse from the membranes. This generalization also applies to the induced penetration of apolar substances through relatively polar hydrophil membrane systems. The application of some of these results to insecticidal work may be shown by the fact that a mixture of ethyl alcohol and kerosene is very toxic to larvæ of the blowfly Calliphora (*vide* Hurst[1]), but mixtures of ethyl alcohol with oleic acid or castor oil are only slightly toxic.

Insect cuticle possesses a high degree of asymmetry depending on the association between the external hydrofuge 'lipoid layer' and the internal hydrophil protein-chitin complex. This asymmetry has an important effect on the permeability of the whole cuticle, and is modified in different insects by the relative distribution and physical properties of the soluble and insoluble components of the cuticle framework. The effects of such asymmetry on permeability may be demonstrated with artificial membranes prepared by impregnating one surface of parchment with collodion or rubber. The simplest approach is to consider the behaviour of the permeating substance within the membrane framework. Each substance diffuses most readily towards that region of the membrane which offers least resistance to its penetration, so that under standard conditions the whole membrane is more permeable in this direction. Experiments have shown that the rate of evaporation of solvents through asymmetrical membranes is greater in the direction of more rapid diffusion.

The differences in permeability in opposite directions through a membrane have long been known to workers with animal membranes[3]. Similar results have been obtained for artificial membranes[4] and plant membranes[5], and it was supposed that this behaviour was due to the 'double' nature of the membranes. The present results throw some light on the underlying mechanism of this behaviour. The importance of asymmetry in membrane permeability is shown by the fact that combinations of asymmetrical membranes may be more permeable to a particular substance than the *single* components of the membrane systems. Water evaporates through the cuticle of Calliphora larvæ more than one hundred times as rapidly in the direction lipoid layer → chitin layer than in the opposite direction, while there is an intermediate rate of evaporation through two such cuticles in which the lipoid layers are in contact. Using various solvents, similar results have been obtained with a number of insect cuticles, plant membranes and artificial asymmetrical systems.

Membrane system		Permeating solvent	Direction of more rapid diffusion	Direction of max. rate of evaporation
A	*B*			
Rubber	Parchment	Water	$A \rightarrow B$	$A \rightarrow B$
,,	,,	Ethyl alcohol	$B \rightarrow A$	$B \rightarrow A$
,,	,,	Kerosene	$B \rightarrow A$	$B \rightarrow A$
Collodion	Parchment	Water	$A \rightarrow B$	$A \rightarrow B$
,,	,,	Ethyl alcohol	$B \rightarrow A$	$B \rightarrow A$
,,	,,	Kerosene	$A \rightarrow B$	$A \rightarrow B$

In the living insect, the cuticle asymmetry is partly regulated by the free lipoid in the outer 'lipoid layer', which is specially adapted to maintain a physiological balance in each particular cuticle. This balance may be upset when the free lipoid from one insect cuticle comes in contact with the cuticle of another. When Calliphora larvæ are allowed to remain in contact with the relatively hard-bodied Tenebrio larvæ, the latter gradually lose water by excessive evaporation and die from desiccation, while there is no increase in the rate of water loss from the soft-bodied insects. This has been correlated with the fact that the free lipoid in the cuticle of Calliphora is distinctly more hydrophilic than that in the cuticle of Tenebrio; a similar desiccation takes place when hard-bodied insects are smeared with lecithin. This does not occur, however, with hard chitinous structures, such as blowfly puparia, where the high degree of impermeability is largely dependent on the insolubility and rigidity of the condensed chitin-protein complex.[6]

In biological systems, asymmetrical colloidal associations occur at various protoplasmic interfaces. The present work indicates that the permeability of such complex associations is not necessarily deducible from summation of the permeabilities of the component phases and suggests a need for reconsideration of certain fundamental assumptions concerning the permeability of membranes.

This work was made possible by means of a grant made to the Imperial College by the Department of Scientific and Industrial Research, and a full account will be given elsewhere.

H. Hurst.

Biological Field Station,
(Imperial College of Science
and Technology),
Slough, Bucks.
March 3.

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[1] Hurst, H., Nature, **145**, 462 (1940).

[2] Kühnelt, W., *Zool. Jahrb., Anat.*, **50**, 219–78 (1928).

[3] Matteucci, C., and Cima, A., *Ann. Chim. et Phys.*, **13**, 63–86 (1845)

[4] Hamburger, H. J., *Biochem. Z.*, **11**, 443–480 (1908).

[5] Denny, F. E., *Bot. Gaz.*, **63**, 373–397 (1917).

[6] Fraenkel, G., and Rudall, K. M., *Proc. Roy. Soc.*, B, **129**, 1–35 (1940)

Isolation of Rhamnose Derivatives from *Ulva lactuca*

Working on algæ other than the Chlorophyceæ, various investigators have established the existence of algal polysaccharides containing mannuronic, galactose or fucose residues, the two latter being in the form of sulphuric acid esters. An investigation of *Ulva lactuca*, a member of the Chlorophyceæ, undertaken with the hope of ultimate correlation with pigmentation, has unexpectedly revealed the presence of a rhamnose polysaccharide, hitherto unknown among algal products.

Without a complete purification of the weakly acidic, non-reducing Ulva carbohydrate, evidence was obtained for an acid sulphuric ester structure and the absence of uronic acid residues. By furfural estimation a methyl pentose content of approximately 25 per cent was established, and on hydrolysis by dilute acids, preferential fissure of the methyl pentose residues occurred to some extent.

Rhamnose was identified as a constituent of the hydrolysate, by a fractional distillation after methylation of the syrupy sugar mixture, and the subsequent isolation of crystalline 2 : 3 : 4-tri-methyl rhamnose anilide and 2 : 3 : 4-tri-methyl rhamnose phenyl hydrazone.

Interruption of this work has prevented the complete identification of a very labile constituent of the hydrolysate. Investigation of the other hydrolysis products, together with an investigation of the methylated polysaccharide, will be undertaken as soon as the work can be resumed.

M. M. T. Plant.
E. D. Johnson.

Royal Holloway College,
Englefield Green,
Surrey.
March 3.

Tadpoles out of Season

By pituitary treatment of an appropriate species of Rana at the appropriate time of year it has been shown by Rugh[1] in the United States that fertilized eggs and developing tadpoles can be obtained the whole year round. I have found that during the winter months (November–February) fertilized eggs and tadpoles of *Rana temporaria* can be readily obtained by the same methods, although the reaction of this species to pituitary treatment is somewhat different.

Briefly, Rugh's techniqueis to inject in saline the whole *partes anteriores* of pituitaries freshly excised from frogs of the same species, into the cœlomic cavity of the adult frog by means of a large hypodermic needle. By controlling the dose and time of injection, amplexus in the male can be made to synchronize with ovulation in the female. In the frogs used by Rugh (*Rana pipiens*, *R. clamitans*, *R. catesbeiana*, *R. sphenocephala*, *Acris gryllus*) egg-laying follows treatment within twenty-four hours at room temperature, although it may be delayed up to five days by smaller doses. In *R. temporaria*, however, a period of about twenty-one days elapses between injection and egg-laying in the female and about eighteen days between injection and amplexus in the male, so that fertilized eggs may be expected about the twenty-first day. Moreover, these times appear to be little affected by variations in dosage, so that control is simple. A single peritoneal injection of 0·25 c.c. of saline containing anything from three to six glands excised from adult females will produce ovulation or amplexus. Six glands excised from adult males will suffice instead. When the frogs begin to copulate each pair should be placed in a separate vessel containing fresh pond water. After the spawn is shed and fertilized some three days later, the frogs should be removed. The tadpoles produced in this way appear to be in every respect normal.

H. Metten.

Department of Biology,
St. Bartholomew's Medical College,
at
The Zoology Laboratory,
Cambridge.
Feb. 28.

[1] Rugh, R., *Science*, 85, 588–589 (1937).

Soil Protozoa in some Chinese Soils

Forty soil samples collected around Kiating and its vicinity, Szechuen, have been studied. Fifty-seven species of Protozoa were recorded: 24 species flagellates, 10 species Sarcodina and 23 species ciliates. Among them, several species were found for the first time in soil. They are, among the flagellates, *Cryptochrysis commutata*, *Peridinium* sp.; among the Sarcodina, *Amœba guttula*, *Amœba striata*; and among the ciliates, *Frontonia* sp., *Chilodon capucinus*, *Chilodon fluviatilis*, *Vorticella chlorostigma*, *Vorticella nutans*. The most common species found are *Oikomonas termo*, *Monas vulgaris*, *Amœba limax*, *Hartmanella hyalina*, *Cercomonas longicauda*, *Nægleria gruberi* and *Colpoda cucullus*. They are present in 70–100 per cent of the samples examined. Casual observations indicate that the greatest number of species found in one single sample is around seventeen, and the least one or two.

The numbers of Protozoa per gram of soil were determined by the dilution method for twenty soil samples. The highest number found was 112,500 (rice field, clay) and the smallest number 65 (barren sand, loamy sand). Flagellates are present in far greater numbers than the Sarcodina and ciliates.

H. Zanyin Gaw.

Physiological Laboratory,
National Wuhan University,
Kiating, Szechuen.
Oct. 1.

Discreteness of Sensations

In 1938 I observed the fluctuation of the threshold of hearing[1]. As proved by recent experiments, this phenomenon is also applicable in the field of vision and touch, and is characterized by the discreteness of sensations.

The phenomenon has been investigated in the following way. The observer receives auditory, visual or tactual impulses of equal duration (0·3 sec.) at equal intervals (0·45 sec.). As the force of the impulse decreases, the impulses become less clear or loud, and they seem to be of lesser duration, according to the integral law of apparent duration[2], but all remain exactly alike as compared with one another. With a further decrease in the force of the impulse, there comes a moment when one or another impulse ceases to resemble the others and appears shorter. This moment is defined as the 'beginning of fluctuation'. When the force of the stimulus is still further decreased, there is a new moment when one or the other impulses vanishes completely—'middle of fluctuation'. The next moment, when all of the impulses vanish, is considered the individual threshold of sensitivity of the given observer, *i*.

Numerous measurements have shown that the beginning of fluctuation comes when the intensity of the stimulus is four times the individual threshold (6 db.), and the middle of fluctuation comes when the intensity is 1·6 times the threshold (2 db.). The intensity of 0·6 of the threshold (0·6 *i*) represents the amplitude of fluctuation, and one and the same values were obtained for hearing, vision and touch. The same value of 0·6 of the threshold was obtained for hearing within the limits of 200–3,000 Herz, although the sensitivity of the ear changes 1,000 times within this range.

The phenomenon of fluctuation of the threshold of sensitivity can be explained if we realize that our sensations increase in jumps, or steps, and, furthermore, that the size of each such step is equivalent to the amplitude of fluctuation, that is, to 0·6 *i* (where *i* is the threshold of sensitivity). I find five such steps, after which they become unobservable as compared to the increased loudness. (Fig. 1).

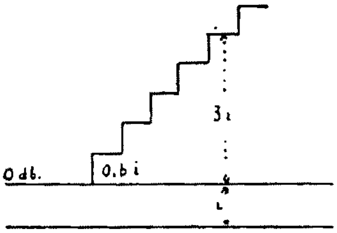

Fig. 1.

Another series of experiments which confirms these results consisted of the following:

A number of impulses having a duration of 0·75 sec. were given, one after the other, at intervals of 0·75 sec. Further, two impulses were given simultaneously, one for vision (a neon lamp connected to a case having an opening of 0·5 cm.), and the other for hearing (a telephone). Thus both impulses are received at the same time. The visual impulse serves as an indicator and its brightness remains constant throughout the duration of the experiments; the loudness of the sound impulse changes. At the beginning, both impulses are of the same duration—both begin and end simultaneously (Fig. 2*a*). As the loudness is decreased, the sound impulse begins to lag, at first scarcely noticeably (Fig. 2*b*); later it lags by half the visual impulse (Fig. 2*c*), and at the end there remains but one element of sensation, one sound dot at the end of the visual impulse (Fig. 2*d*). This takes place when the intensity of sound is equal to 1·6 *i* (when the loudness is 2 db.), that is, exactly at an intensity which corresponds to the middle of fluctuation.

The time by which the sound impulse lags corresponds exactly to the time necessary for the accumulation of the elementary work of sound (1·6 *it*), which is necessary for one element of sensation.

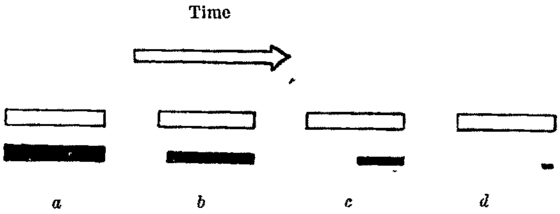

Fig. 2.

The experiments confirmed very well the equation connecting the intensity of sound, *I*, the individual threshold of the observer, *i*, the duration of the impulse, *t*, and the extent of the lag Δt:

$$10 \lg \frac{I}{i} = 2 + 10 \lg \frac{t}{\Delta t} \qquad (1)$$

The visual and sound impulses can be interchanged: the sound will then serve as an indicator and the visual impulse will vary in brightness. The visual impulse will then lag and will be shortened, as shown in Fig. 2. The element of visual sensation will be obtained when the intensity of light is equal to 1·6 *i*, and the time of the lag can be determined from equation (1). Experiment has shown that the same thing occurs with the tactual impulse. In this case, the indicator may be either the visual or the sound impulse.

Other experiments with impulses of greater duration have shown that the time for the accumulation of the elementary work of the impulse may reach many seconds.

SAMUEL LIFSHITZ.

Institute of Architecture,
Moscow.

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[1] Lifshitz, S., *J. Acous. Soc. Amer.*, 11 (1938).

[2] Lifshitz, S., *J. Acous. Soc. Amer.*, 5, 31 (1933); 7, 213 (1936).

Catalysis by Activated Copper Sulphide

60 gm. carefully purified acetaldehyde and 30 gm. copper sulphide, activated by oxidizing a part of its surface into cupric sulphate, were sealed in a tube of Pyrex glass and kept at 15–20° for 24 days. At the end of this time, 60 per cent of the reactant was converted into paraldehyde, which was identified by determining the boiling point, the melting point and the mixed melting point with an authentic sample. In a control experiment without catalyst, 98 per cent of the acetaldehyde could be recovered.

It follows that the activated copper sulphide is a catalyst not only for the conversion of certain petroleum hydrocarbons[1] but also for a low molecular polymerization involving the opening of a carbonyl bond.

ALBERT WASSERMANN.

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[1] Wassermann, *Brit. Pat.*, 499958, French Pat., 838379, U.S.A. Pat., filed May 1938, Application No. 208695. Ingold and Wassermann, *Trans. Farad. Soc.*, 35, 1022 (1939).

STONE AGE MAN IN CEYLON

P. E. P. DERANIYAGALA has written an important paper entitled "The Stone Age and Cave Men of Ceylon (*J. Roy. Asiatic Soc.*, Ceylon Branch, **34**, 92; September 1940). Before 1936, the conclusions at which specialists had arrived relating to the prehistoric stone artefacts of Ceylon were extremely divergent owing to the absence of glacial deposits and of vertebrate fossils upon which these conclusions might be based. The second impediment no longer exists. Recent discoveries of an extinct hippopotamus, rhinoceros and race of elephant associated with stone artefacts may, it is argued, be assigned to the Upper Pleistocene, being younger than the Narbudda deposits of the Middle Pleistocene in which the hippopotamus occurs with three extinct proboscidian genera. The presence of the lion fossil and the absence of tiger and king cobra in Ceylon suggest that the island's extinct fauna entered before the last two descended far into peninsular India, while the absence of the horse indicates that the large extinct mammals entered Ceylon after the extinction, temporary or final, of this ungulate in India. If this be correct, these fossils of Ceylon must be regarded as comparatively recent; nor can the primitive stone artefacts be held to be the earliest handiwork of man, while the hitherto unexplored river terraces may reveal an earlier phase when stone cultures began in the island.

Man possibly entered Ceylon before developing the technique of making implements of stone, and acquired this art independently after the isolation of the island. Lacking the incentive of northern invasian which affected his continental relatives, he failed to advance beyond a phase akin to the Abbevellian, in which indeed he remained almost to the end of the early stone age culture of Ceylon in Pleistocene times or later. The poorly developed second phase of early stone age culture was replaced by the neolithic by a transition sufficiently abrupt to suggest that Ceylon's palæolithic man accompanied the hippopotamus and other large mammals into extinction, possibly as a result of an arid spell. The further possibility exists that when India and Ceylon were reconnected, the stone age races of India overran the island, and palæolithic man, if not already extinct, was unable to withstand their superior numbers and more efficient weapons.

The tendency of the Veddas to throw back to two physical types differing from other races in Ceylon, suggests that more than one neolithic race entered the island, a view supported by the occurrence in India of certain ancient pre-Dravidian races—Irula, Panyan, Kurumba, etc.

During Pleistocene times and later, Ceylon seems to have been united with India during both warm and cold spells. The final separation was still incomplete even so late as early historic times, as appears in the Ramayana. In addition, the topography of Ceylon fluctuated considerably, earth movements apparently bringing about a swift river phase, which was replaced by a phase of slow rivers and lakes, followed by further movement in which the lakes and many rivers disappeared, leaving only small streams or a series of swamps. The broad valley between the central mountain mass of Sri Padhé, or Adam's Peak, and the outlying range to its south-west is a source of fossils and artefacts, which also occur in the adjoining strike valleys. These comprise the Ratnapura series, which display much superficial laterization, possibly as a result of the south-west monsoon.

As the best evidence, both palæontological and archæological, is derived from the deposits of the strike valleys of this area, it is proposed to give to this stone age culture the name *Ratnapura*. It comprises two phases, of which the lower and earlier is extremely crude without any well-defined general shapes, has a crude flaking technique with scarcely any retouching, and contains a considerable proportion of pebble artefacts. The implements are about half the size of the quartzite palæoliths of Madras and show more affinity to the early Soan of Northern India. The materials employed are chert, quartz, corundum and jasper. The upper Ratnapura implements are smaller than those of the lower culture, and show some attempt at retouching, scraper-like forms and the commencement of a crude hand-axe; and also entire crystals of quartz or corundum, sometimes flaked to a sharp edge at the apex and roughly chipped, were employed. The upper phase did not develop far before it became extinct.

The relative scarcity or absence of palæoliths from the highest of the peneplanes of Ceylon suggests that during palæolithic times this region was too cold for autochthonous tropical races, as it is partially to-day. Since neolithic implements abound here, it is possible that either one neolithic race was driven into the cold area by another, or that all the neolithic races were forced into it by the advent of metal-using man. Being thus thrown together, they interbred and degenerated into the so-called Veddas, who never manufactured metal implements and use shells for this purpose down to the present day. Neolithic man inhabited caves, and his implements appear to be mainly composite, that is, set in a wooden handle, as the stone artefacts are too small for use as single weapons. These stone artefacts usually occur at two levels, those of the lower being twice as large as those from the upper, which also possesses a greater number of types. The culture failed to develop so far as that of India, and the art of grinding and polishing was almost unknown. Generally, the implements are little worked if made of quartz; but occasional pigmy implements are as delicately finished as Solutrean. The name Balangoda is proposed for this culture, after the cave from which the implements are best known. The common type of pottery found in the deposits has a wicker or mat-basket design, but another form, probably prehistoric, has a wicker-loop design on the inner surface. Certain types of potsherd found in both neolithic and protohistoric appear to have survived with little variation down to modern times. Pieces of hæmatite show flat surfaces where they have been ground for pigment. Bone splinters ground to a point at one or both ends were possibly used as borers, needles, or for fishing.

The best prehistoric deposits occurred in caves notably difficult of access, but close to a stream which flowed down the rock near the entrance. Each cave possessed a sandy outer platform with a look-out rock, and lay under the shelter of a large overhanging shelf of rock. Neolithic man generally piled his refuse not at the cave mouth but on one side of the platform.

A number of the caves have been investigated, and from the evidence of the deposits of which details are given, it is apparent that the neolithic colony inhabiting a rock shelter comprised several families, of which the men were hunters, trappers and fishers, while the women collected fruit, nuts and shell-fish. Some degree of agriculture may have been practised. Calcined bones furnish evidence of the use of fire and the practice of roasting game.

PRODUCTION OF DRUGS WITHIN THE BRITISH EMPIRE

THE Appendix to the recently published War Memorandum by the Medical Research Council on "Economy in the Use of Drugs in War-Time" (H.M. Stationery Office. 3*d.* net) is of more durable interest than the body of the Memorandum, since it proposes a long-term plan for the cultivation of medicinal plants, whereas the special need for economy in the prescription of scarce drugs will pass with the emergency. The Appendix consists of two lists of drugs the cultivation of which in the British Empire should be encouraged. The first list relates to domestic production and the second to production in the Colonial Empire. It is not proposed to comment, in this note, on all the items named in the Appendix, but to make a few observations based upon the results of experimental work designed to ascertain whether it is feasible to cultivate economically and on a commercial scale, either at home or in some Empire country overseas, certain medicinal plants for the supply of which Great Britain has paid tribute in the past to foreign nations.

Taking first the list of drugs which the Memorandum recommends for production in the United Kingdom, it is proposed to refer to cascara sagrada, ergot, dill, gentian and lobelia. In the past the bulk of Great Britain's large imports of cascara sagrada has been supplied from forests on the American side of the north-west Pacific coast; contributions from the Canadian side have been comparatively small. Experiments have proved that the shrub from which the bark is peeled can be grown in certain soils in Great Britain as a coppice crop on a five-year rotation. An additional advantage of home cultivation is that the wood remaining after the bark has been peeled from it could be converted into charcoal equal in quality to that obtained from alder buckthorn for the manufacture of explosives.

Ergot, of which large quantities are consumed by the British drug manufacturing industry, is supplied mainly by Portugal and Spain. It could be produced in Great Britain, the most favourable places for this purpose being in the west of England and in Wales. Already plans have been laid for experiments, and research workers are devoting attention to the selection of the species and strain of the fungus. It is satisfactory to know that the danger of a serious infection of cereals other than rye is slight. The aim is to select strains of high alkaloidal content, and it may be observed that much of the information concerning the alkaloidal content dates back to the time before the discovery of the alkaloid ergometrine. Chemical methods of analysis for differentiating water-soluble alkaloid (ergometrine group) from water-insoluble alkaloid (ergotoxine group) have been devised, and it seems desirable that cultivation experiments should be controlled on this basis. Incidentally, publications from the Pharmacopœia laboratory have indicated the possibility that the official standards of the British Pharmacopœia will be eventually on this basis.

Dill, which was formerly supplied largely from Germany, can be grown as a cover crop with caraway, the dill being harvested in the first year and the caraway in the second; similarly, coriander, which is already cultivated in England, may be used as a cover crop for caraway. With regard to gentian, which in normal times was imported from Italy, Spain and France, there are definite grounds for stating that it could be grown in Great Britain, but several years are needed to develop the large roots which are preferred in the London drug market. Lobelia, the present source of supply of which is the United States, can be grown on moderate to light soils in the southern half of England.

Coming now to the list of some forty vegetable drugs and essential oil-yielding plants which the Memorandum recommends for cultivation in some parts of the British Empire overseas, it is satisfactory to know that the following are already in production in India: nux vomica, podophyllum resin, rhubarb, belladonna, digitalis, henbane, jalap, lobelia, opium, squill, senna, santonin, karaya gum, and the following oils: arachis, eucalyptus, hydnocarpus and castor. The cultivation in India of psyllium and agar could also be developed, and there seems but little reason to doubt that some of the soils and climates of India are suitable for the cultivation of some of the other substances in the list set out by the Medical Research Council.

Australia, too, and New Zealand are countries which can supply some of Britain's needs for drugs. Such substances as digitalis, ephedra, ergot, liquorice, peppermint and pyrethrum, should repay investigation by cultivation in suitable places in Australia. The leaves of a tree indigenous to Australia contain hyoscyamine and hyoscine, and should prove a valuable source of these alkaloids. New Zealand is already a potential source of digitalis; it is produced there in commercial quantities. The species of fungus which grows on Festuca ergot in New Zealand is esteemed as a source of ergotamine. Many other drugs in the list could be grown economically in that Dominion. Canada has not been a fruitful source of vegetable materia medica, but there is little doubt that some of the drugs which are supplied by the United States could be cultivated successfully in Canada. Another British country which has given good promise as a source of vegetable drugs is Kenya, and it is understood that official encouragement will continue to be given to experimental stations in this colony.

FORTHCOMING EVENTS

Monday, March 31

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 5 p.m.—Mr. S. H. Beaver: "Railways of the Balkan Peninsula".

Wednesday, April 2

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Rt. Hon. Lord Horder: "The Modern Troglodyte".

Institution of Naval Architects (at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2). Eighty-second Annual Meeting.

Thursday, April 3

Chemical Society (at Burlington House, Piccadilly, London, W.1), at 12 noon—Hundredth Annual General Meeting. 2.45 p.m.—Sir Robert Robinson, F.R.S.: "The Mechanism of the Benzidine Rearrangement and some Related Topics".

Linnean Society of London (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Sir Arthur Hill, F.R.S.: "The Centenary of the Royal Botanic Gardens, Kew".

Friday, April 4

Institution of Chemical Engineers (at the Connaught Rooms, Great Queen Street, London, W.C.2), at 11 a.m.—Nineteenth Annual Corporate Meeting. 11.45 a.m.—Presidential Address: "Some Post-War Problems".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Chemist at Thorpe Power Station—The City Electrical Engineer, 4 Duke Street, Norwich (April 2).

Teacher in the Mechanical Engineering Department—The Principal, Technical College, Wolverton, Bucks. (April 4).

Assistant Inspector (male) of Schools—The Director of Education, Education Office, Chapel Street, Salford 3 (April 5).

Principal of the Cardiff Technical College—The Director of Education, City Hall, Cardiff (April 7).

Headmaster for St. John's School, Concepcion, Chile—The British Council, 3 Hanover Street, London, W.1 (quoting 'Concepcion') (April 9).

Master for St. Julian's School, Carcavelos, Portugal, to teach Mathematics and Elementary Science—The British Council, 3 Hanover Street, London, W.1 (quoting 'Portugal') (April 9).

Assistant Lecturer in the Department of Physiology—The Secretary, The University, Edmund Street, Birmingham 3 (April 25).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Freshwater Biological Association of the British Empire. Scientific Publication No. 4: A Key to the British Water Bugs (Hemiptera-Heteroptera, excluding Corixidae), with Notes on their Ecology. By Dr. T. T. Macan. Pp. 36. (Ambleside: Freshwater Biological Association of the British Empire.) 1*s*. 6*d*. [192

India at War: a Record and a Review, 1939–1940. By Sir George Dunbar. Pp. 32. (London: H.M. Stationery Office.) 2*s*. 6*d*. net. [192

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 10: The Arborescent *Senecios* of Kilimanjaro, a Study in Ecological Anatomy. By C. Leighton Hare. Pp. 355–371+2 plates. (Edinburgh and London: Oliver and Boyd.) 3*s*. [192

The Lily Year-Book, 1940. (No. 9.) Pp. iv+96+27 plates. (London: Royal Horticultural Society.) 5*s*. [272

University of Liverpool: Social Science Department, Statistics Division. Cost of Living of Representative Working Class Families. Pp. 28. (Liverpool: University Press of Liverpool; London: Hodder and Stoughton, Ltd.) 1*s*. [282

Sheffield City Libraries. Research Bulletin No. 5: A Select Bibliography on the Production of Steel Sheets and Strip, Part 3: Sheet and Strip Testing and Inspection. Pp. 24. (Sheffield: Central Library.) 3*d*. [63

Other Countries

City of Durban: Durban Museum and Art Gallery. Annual Report for Municipal Year 1939–1940. Pp. 12+4 plates. (Durban: Durban Museum and Art Gallery.) [122

Smithsonian Miscellaneous Collections. Vol. 99, No. 18: Two New Races of Passerine Birds from Thailand. By H. G. Deignan. (Publication 3605.) Pp. ii+4. (Washington, D.C.: Smithsonian Institution.) [122

Colony of Mauritius: Department of Agriculture. Sugarcane Research Station Bulletin No. 17: An Investigation into the Origin of the Sugarcane Variety Uba Marot, by G. C. Stevenson; The Spread of New Varieties of Sugarcane in Mauritius, by N. Craig. Pp. 18. (Port Louis: Government Printer.) 25 cents. [122.

Pocket Natural History No. 8 (Zoological Series No. 3): A Field Key to our Common Birds. By Irene T. Rorimer. Pp. 160 (18 plates). 1.50 dollars. Pocket Natural History No. 9 (Geological Series No. 1): The Geology of the Cleveland Region. By Dr. Arthur B. Williams. Pp. ii+62. 50 cents. (Cleveland, Ohio: Cleveland Museum of Natural History.) [122

United States Department of Agriculture. Technical Bulletin No. 706: Wild Animal Damage to Seed and Seedlings on Cut-over Douglas Fir Lands of Oregon and Washington. By A. W. Moore. Pp. 28. 5 cents. Technical Bulletin No. 741: Three Species of the Genus *Lygus* and their relation to Alfalfa Seed Production in Southern Arizona and California. By Loyd L. Stitt. Pp. 20. 5 cents. (Washington, D.C.: Government Printing Office.) [142

Proceedings of the American Academy of Arts and Sciences. Vol. 74, No. 7: A Revision of the Nearctic Hemerobiidae, Berothidae, Sisyridae, Polystoechotidae and Dilaridae (Neuroptera). By F. M. Carpenter. Pp. 193–280+3 plates. (Boston, Mass.: American Academy of Arts and Sciences.) 2.25 dollars. [192

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 20, Nos. 12, 13, 14: Report of the President of the Academy for the Year 1931, by C. E. Grunsky; Report of the Director of the Museum and of the Aquarium for the Year 1931, by Barton Warren Evermann; Report of the President of the Academy and Acting Director of the Museum and the Aquarium for the Year 1932, with Departmental Reports for the Two Years 1931 and 1932, by C. E. Grunsky. Pp. 473–522. Vol. 23, No. 29: The Neotropical Anchovies of the Genus *Amplova*. By George Sprague Myers. Pp. 437–442. (San Francisco: California Academy of Sciences.) [192

Department of Agriculture: Trinidad and Tobago. Vol. 1, Part 7: Flora of Trinidad and Tobago—Myrtales (concl.), Passiflorales, Ficodales, Umbellales. By E. E. Cheesman. Pp. 411–464. 54 cents. Vol. 2, Part 2: Flora of Trinidad and Tobago—Asterales, by E. E. Cheesman; Campanales, by E. E. Cheesman; Ericales, by A. W. Hill and B. L. Burtt; Primulales, by E. E. Cheesman. Pp. 49–122. 84 cents. (Port of Spain: Government Printing Office.) [192

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 134: Studies on Bovine Mastitis, 1: Study of an Experimental Herd. From the Division of Animal Health and Nutrition. Pp. 10 + 74 plates. (Melbourne: Government Printer.) [192

Smithsonian Miscellaneous Collections. Vol. 99, No. 14: The Male Genitalia of Hymenoptera. By R. E. Snodgrass. (Publication 3599.) Pp. ii+86+33 plates. Vol. 99, No. 17: Increased Stimulation of the Alga *Stichococcus bacillaris* by Successive Exposures to Short Wave Lengths of the Ultraviolet. By Florence Meier Chase. (Publication 3603.) Pp. ii+16+2 plates. (Washington, D.C.: Smithsonian Institution.) [192

United States Department of Agriculture. Circular No. 572: Life History and Control of the Imported Willow Leaf Beetle. By Clifford E. Hood. Pp. 10. (Washington, D.C.: Government Printing Office.) 5 cents. [192

Proceedings of the United States National Museum. Vol. 89. No. 3097: Seven New Crayfishes of the Genus *Cambarus* from Florida, with Notes on other Species. By Horton H. Hobbs, Jr. Pp. 387–424. (Washington, D.C.: Government Printing Office.) [192

The Engineering Foundation. Annual Report, October 1, 1939, to September 30, 1940. Pp. 48. (New York: The Engineering Foundation.) [192

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 101: Studies of the Physiology and Toxicology of Blowflies. 2: The Action of Stomach Larvicides on *Lucilia cuprina*, by F. G. Lennox; 3: The Toxicity of some Arsenicals to Larvae of *Lucilia cuprina*, by F. G. Lennox and L. G. Weber; 4: The Action of Contact Larvicides on *Lucilia cuprina*, by F. G. Lennox. Pp. 131. Pamphlet No. 102: Studies of the Physiology and Toxicology of Blowflies. 5: The Hydrogen Ion Concentration in the Alimentary Canal, by D. F. Waterhouse; 6: The Absorption and Distribution of Iron, by D. F. Waterhouse; 7: A Quantitative Examination of the Iron Content of *Lucilia cuprina*, by F. G. Lennox. Pp. 67. (Melbourne: Government Printer.) [202

Smithsonian Institution: Bureau of American Ethnology. Bulletin 127: Linguistic Material from the Tribes of Southern Texas and Northeastern Mexico. By John R. Swanton. Pp. v+145. (Washington, D.C.: Government Printing Office.) 20 cents. [202

Proceedings of the United States National Museum. Vol. 89, No. 3095: Revision of the Scarabæid Beetles of the Phyllophagan Subgenus *Listrochelus* of the United States, with Discussion of Related Subgenera. By Lawrence W. Saylor. Pp. 59–130. (Washington, D.C.: Government Printing Office.) [202

United States Department of Agriculture. Technical Bulletin No. 740: Studies of Methods and Materials for the Control of the Leafhopper *Empoasca fabæ* as a Bean Pest. By Dwight M. DeLong. Pp. 64. (Washington, D.C.: Government Printing Office.) 10 cents. [242

Bulletin of the Bingham Oceanographic Collection. Vol. 7, Art. 3: Plankton Studies, 3: Long Island Sound. By Gordon A. Riley. Pp. 93. (New Haven, Conn.: Yale University.) [242

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ASPECTS OF RECONSTRUCTION—I

THE importance already attached by the Government to post-War reconstruction was seen in the changes in the machinery of government recently announced. Mr. Arthur Greenwood, the Minister without Portfolio, has now relinquished his oversight of the economic field and, while remaining in the Cabinet, has undertaken responsibility for the study of reconstruction and post-War problems. Later on, it is stated, when the end of the War can be more clearly foreseen, a ministry will be formed for this purpose. Meanwhile, Mr. Arthur Greenwood will be chairman of the group of Ministers.

In the attention which has been focused on the question of production and man-power and the effect of the changes simultaneously announced in that field, this part of the statement has been somewhat overshadowed. The statement, however, points out that the object will be to find practical solutions for the immediate problems of a transition from war to peace, and also to outline and presently to amplify a policy for the years immediately following the War which will command the support of the nation as a whole and enable united action to proceed in peace as in war. Mr. Greenwood has himself described some of the problems that he and his colleagues have specially in mind, and it is worth noting that he brings to this task the experience that he gained in the War of 1914–18. He was an active and resourceful member of the first Reconstruction Committee set up by Mr. Asquith's Government in 1916, and then of the Ministry of Reconstruction set up by Mr. Lloyd George in 1917.

Mr. Greenwood has said that the country will not tolerate the spectacle of abject poverty or the curse of unemployment. Our educational system and our social services will be developed, and plans are being made to abolish ugliness and hovels in our towns. Mr. Greenwood has spoken, too, of his desire that the free spirit of man should emerge from the ruins of the War, and referred to the problem of unemployment. In remoulding our economic system it must indeed be a prime concern to preserve and increase the enjoyment of those rights and liberties that have been overthrown in the totalitarian States, and which we have entered on this struggle to uphold.

There is abundant evidence that Mr. Greenwood and his colleagues are not thinking ahead of the nation, but are giving expression to thoughts and aspirations occupying the minds of many already in the midst of their concentration on the immediate task of winning the war. The undercurrent of questionings with which Lord Reith's appointment as Minister of Works and Building was received, and the type of informed criticism which has greeted his appointment of Mr. T. S. Tait as director of standardization, show the live interest which is already taken in this question of reconstruction. Other noteworthy examples are to be seen in the address on "Trends in Nutrition" given by Sir John Orr before a meeting of the Leeds Branch of the British Medical Association last autumn, and recently published in the *British Medical Journal*, the fine address on "Problems of Building Reconstruction" delivered by Mr. D. E. E. Gibson, the city architect, Coventry, before the Royal Society of Arts early last December, and the admirable report of the Committee of the Town Planning Institute on Compensation and Betterment.

An outstanding discussion of the wider issues of reconstruction has been contributed to the

Round Table of January under the title "Reconstruction : Ends and Means", which as a contribution to lucid thinking about this important matter deserves widespread attention and has real claims on the notice of scientific workers. It demonstrates why this marked growth of the readiness to re-examine the foundations of our society is timely and should be encouraged, and gives us yet another weighty reminder that, as the experience of the last Ministry of Reconstruction showed, reconstruction must be planned now or never. It is not true that the opportunity will come when the victory is won ; the opportunity will then disappear. It is the fires of war that have softened the framework of our society, and we must strike while the metal is malleable if we are to determine its new shape.

There are, of course, many things that are physically unattainable in war-time, but this article in the *Round Table* makes once more the point that has been repeatedly urged in these columns : plans for reconstruction—provided they reflect the unity of the nation and do not disturb it—are not a hindrance to the strategists ; they are a necessary part of the grand strategy of victory, both at home and abroad. In them we can take a spiritual offensive, and proving among our own people that democracy is a cause as bold and dynamic, as young and as forceful as any tyrant's 'New Order', we shall not have to coax allies to our standard.

This note, so clearly sounded in President Roosevelt's inaugural address on January 20, shows indeed where the strongest hope of enduring Anglo-American co-operation lies, and how much a bold and creative policy of reconstruction might do to secure American support in the wider task of international economic reconstruction after the War. Moreover, the article shows how little reason there is to be pessimistic about our powers of recovery or resources for reconstruction. Productive resources are unlikely to be materially reduced, and the immensely lighter toll of life which the first sixteen months of the War have claimed as compared with experience in 1914–18, to which the Prime Minister recently referred in dealing with our man-power resources, suggests that our position is likely to be stronger rather than weaker than in 1918, because the real capital of the nation, its man-power and woman-power and the moral and spiritual resources, are less impaired whatever the material destruction.

It has been suggested that at present it is the sorts of reconstruction that require clear definition rather than the sketching of any specific measures. There is anxiety that action taken in war should not, if at all avoidable, prejudice the future. Moreover, we are developing our organization and our plans for obliterating the damage due to air raids. Even this reconstruction in the literal sense of the word is not a simple job. Someone must at least decide which buildings shall be rebuilt first. Moreover, since we shall not generally have the opportunity of starting again from the beginning, the only real choice is between a good job and a bad job of patching. The need for very careful forethought and planning is accordingly all the greater, and even in this small subdivision of the whole question of reconstruction, the problems are immense and afford Lord Reith a magnificent opportunity.

To the extent of those opportunities the address of Mr. D. E. E. Gibson, already mentioned, bears striking testimony. Social and economic changes of far-reaching significance are already taking place, and if we are to use the opportunities which they and the destruction due to air attack afford, some of the thinking involved in planning must be done now. Moreover, if we postulate as a material ideal the right of every man and woman to a healthy and beautiful environment, national as well as local planning is required.

Mr. Gibson accordingly advocates the formation of a committee, armed not merely with the knowledge already existing in the P E P report and the report of the Barlow Commission, but also with the widest powers possible in war-time. No vested interest should be allowed to withhold from it information necessary for the preparation of a long-term plan. The keynote of this committee and of the local town-planning committees linked with it should be decentralization and regeneration—an attempt to reverse the present tendency and encourage a network of clean, healthy towns.

This suggestion would appear to have been adopted in essence by Lord Reith, who, in the House of Lords on February 26, stated that he was inviting a dozen or twenty individuals who had special experience to assist him, and to be associated from the beginning in a consultative capacity with the central planning and co-ordination of post-War physical reconstruction. Lord Reith also proposes to use the resources of other departments and to ask for the collaboration of professional and technical associations. An offer from the council of the Royal Institute of British Architects has already been welcomed by him. Lord Reith also stated that he has been authorized to proceed on the assumption that the principle of planning would be accepted as national policy, and that some central planning authority would be required which would proceed on a positive policy for agricultural and industrial development and transport, and that some services would require treatment on a national basis, some regionally, and some locally.

Besides this question of national planning and all that is involved in the use of the land, and the subordination, for the good of the community, of private interests to public ones, there is an immense field for technical development. Too seldom does the architect or builder remember that it is his duty to-day to make his design—whether house or public building or factory—suit the needs of the people, and achieve beauty with the use of all the technical advances at his disposal. Mr. Gibson was able to point to the way in which developments and new ideas are being incorporated in houses now being constructed in Coventry, and he urged that to build for permanence is a mistake, limiting or hampering the satisfaction of the needs of to-morrow.

These are revolutionary ideas to many, but it is only by recognizing their force that we can hope to utilize to the full the new knowledge and materials which science is placing at the disposal of the building industry to satisfy the cultural and æsthetic needs of the community, as well as its material needs. They may involve departure from traditional practice and organization, and Mr. Gibson himself advocates the establishment now of a committee of architects, to face these problems, with representatives from aircraft works both on the design and organization sides, and of the Building Research Station, so that the new forms of construction may be ready when the call comes and the transition of factories from war-work to the production of houses, using the light, efficient and beautiful materials which are employed with such efficiency and economy in aircraft, may be facilitated. Moreover, the work of the architect, the planner and the engineer must go hand-in-hand, with a clear definition of the spheres in which each can best serve the community. For the building industry, Mr. Gibson visualizes a new type of educational centre—a combination of technical school, architectural school and town-planning department, in which students would learn to handle and work on materials in the early years and would be sifted out in accordance with their talents and ability, the most gifted becoming planners of the future environment.

INDEX LONDINENSIS

Index Londinensis to Illustrations of Flowering Plants, Ferns and Fern Allies

Supplement for the Years 1921–35. Prepared under the auspices of the Royal Horticultural Society of London at the Royal Botanic Gardens, Kew, by W. C. Worsdell, under the direction of Sir Arthur W Hill. Part 1: A—H. Pp. vii+497. Part 2: I—Z. Pp. iv+515. (Oxford: Clarendon Press; London: Oxford University Press, 1941.) 2 vols., £10 10*s*. 0*d*. net.

The appearance of this supplement to "Index Londinensis" is an event of more than ordinary interest to all botanists and scientific horticulturists. Its production in time of war in the same style and with the same high standard of excellence which marked the original work will be regarded as a fine achievement.

The first and for many years the only work of its kind was Pritzel's "Index Iconum Botanicarum", published in 1855. This provided a convenient alphabetical register of illustrations of flowering plants and ferns selected from botanical literature from about the time of Linnæus onwards. During the latter part of the nineteenth century, however, the rapid progress of botanical science and the increasing use of illustrations in botanical writings made it desirable that Pritzel's "Index" should be revised and brought up to date. This was a task of no small magnitude, but thanks to the enterprise and support of the Royal Horticultural Society the work was successfully accomplished, and the six volumes of "Index Londinensis" were issued at intervals between 1929 and 1931, under the editorship of the late Dr. O. Stapf of the Kew Herbarium. The work was an emended and enlarged edition of Pritzel's original register, which now possesses only historic interest, and included all references to figures of flowering plants and ferns down to the end of the year 1920.

Although the six volumes of "Index Londinensis" were estimated to contain nearly five hundred thousand entries, they were no sooner published than work on a supplement was commenced. The two volumes now before us are a handsome addition to the main work and are sure of a warm welcome from all who know the value of the original. The supplement has been prepared under the supervision of the Director of the Royal Botanic Gardens, Kew, with the assistance of Mr. W. C. Worsdell as sub-editor, while the onerous task of compilation has been undertaken by Miss R. L. Burford. Not only does the supplement provide the student with a great array of references to botanical drawings taken from periodicals and independent works published during the years 1921–35, but it directs attention also to an extensive and widely scattered literature much of which might easily be overlooked.

In the preparation of the supplement, the general plan and scope of the main work have been closely followed. The text is clearly printed in three columns to the page, with generic names of plants as page-headings. In each column, plant names are printed in clarendon type, and under each genus the names of species are arranged in alphabetical order, while the references under species-names are placed in chronological sequence. Since the period covered by the supplement is the comparatively short one of fifteen years, it is not altogether surprising that only one or two references to figures appear under many of the names of species. Yet the size of the two volumes (more than one thousand pages) is to some extent a measure of the amount of taxonomic and morphological work which botanists have accomplished on flowering plants and ferns during the years 1921–35. Nor have all references been given, for the supplement, unlike the main work, "contains under most of the species-headings, only a selection of references, thus keeping its size within certain limits". On the average, about seventy names of species appear on each page, so that references are given to some seventy thousand species altogether. The consequences of intensive study of certain groups are plainly seen throughout both volumes. Six or more pages are taken up, for example, with the references to such genera as Bulbophyllum, Carex, Eucalyptus, Sedum, Rhododendron and Quercus.

The system of cross-references will again be welcomed. It is difficult even for the trained botanist to keep abreast of all the changes in plant nomenclature, and we can well believe that even the specialist in grasses, when he turns to the genus Poa, will be grateful for being told to see also Atropis, Festuca, Glyceria, Sclerochloa and Sesleria, or the pteridologist for the note under Aspidium to consult also Dictyocline, Dryomenis, Dryopteris, Lastrea, Nephrodium and Polystichum.

We would have been grateful for the inclusion in the supplement of an explanation of the symbols which are employed to indicate the nature of any given illustration, whether in colour, etc. Only in volume I of the main work are the symbols explained. Again, many of the references are to photographic illustrations, but there does not appear to be any indication of this under the several entries. The omission, however, is a small one, and we have nothing but praise for those who have in any way contributed to the preparation of the supplement, and a special word of gratitude to the Royal Horticultural Society for having shouldered the cost of its production.

From the preface we learn that the supplement concludes the "Index Londinensis", and although no further supplements are to be published, references to new illustrations will be included in future supplements of the "Index Kewensis". The whole publication now brought to successful completion is an invaluable and indispensable work of reference, and it should find a place in every botanical library.

J. R. MATTHEWS.

THEORY OF ELECTRODYNAMICS

Electrodynamics

By Prof. Leigh Page and Prof. Norman Ilsley Adams, Jr. Pp. xii + 506. (New York: D. Van Nostrand Co., Inc., 1940). 6.50 dollars.

ELECTRICITY and magnetism, like mechanics, being a subject of great importance and interest, both practical and theoretical, is widely taught. Even more than mechanics it offers scope for a variety of treatment in teaching, and because many teachers have felt that their particular methods are of general interest, the number of text-books and treatises on electricity and magnetism is considerable and ever increasing. Apart from the distinctive views of different teachers, there is need for a variety of treatments, because of the varied needs, outlook and equipment of different types of student. In time a consensus of opinion on the best methods appropriate to each type of student may be arrived at; the good features of groups of good books of similar type and scope may then be combined, by some future

Euclids of the subject, in single volumes replacing the present books in each group. But the time for this has certainly not yet come; there remain great differences of opinion as to some parts of the theory, even on apparently elementary points; still further distant is the time when a best mode of transition from the classical to the quantum theory will be generally agreed upon. Many new essays of exposition must be made before the presentation of the higher parts of the subject attains relative stability and uniformity.

In a recent issue of NATURE (146, 446; 1940) a treatise "Static and Dynamic Electricity" by Prof. W. R. Smythe was enthusiastically welcomed by Prof. G. Temple, who from his own experience in using it as a research tool had found that it successfully achieved this its avowed object. An advanced treatise of a very different type, by Profs. Page and Adams, now under notice, lays special stress on the *theoretical* aspects of electrodynamics, and almost entirely omits electrostatics and magnetostatics, on the ground that they are already excellently treated elsewhere. This naturally limits the appeal of their book, but it is to be warmly welcomed as an original and carefully considered exposition of the subject from a logical point of view. Its special feature is that the relativistic attitude is adopted from the outset, and Maxwell's field equations are deduced on the basis of the emission theory. The authors have, however, made no attempt to include quantum electrodynamics or any of the special results of the quantum theory.

The book uses vector and tensor methods throughout, and the first chapter (77 pp.) gives an excellent condensed exposition of the main vector and tensor theory needed later. Chapter II (51 pp.) deals with the principle of relativity, first for a one-dimensional and afterwards for a three-dimensional system, leading to the Lorentz space-time transformation; the treatment in this chapter is a modified form of that given by Prof. E. A. Milne in his book "Relativity, Gravitation and World Structure."

The discussion of the electromagnetic field begins (Chapter III) with an extension of Faraday's conception of lines or tubes of force. Every element of the charge is regarded as the focus of a bundle of tubes, interpenetrating, but not influencing the tubes from other charges: the number of tubes for any element of charge is taken as identical with the number of units of electricity in the charge, "and we are led automatically to the Heaviside-Lorentz units". Each element of charge is regarded also "as a group of emittors each of which shoots forth a stream of moving-elements with the velocity of light, in much the same way as a machine gun fires a stream of bullets. The locus, at any instant, of the moving-elements which have been projected from a given emittor, constitutes a line of force. Now we shall adopt two assumptions suggested by symmetry. First we assume that, relative to the inertial system in which the element of charge is momentarily in rest, the emittors are distributed uniformly at angle, and second, that the emittors have no rotation relative to this inertial system". The electric intensity **E** at a point P is defined by the property that its component in any direction **n** is equal to the number of tubes of force (from the elementary fields of all the charges) that cross an element of area through P, normal to **n**, per unit area.

The relativity transformation of **E**, thus defined, for a single elementary field, from one inertial system to another, introduces the vector product $(1/c)\, \mathbf{c} \wedge \mathbf{E}$, where **c** is the velocity of the moving-element at P; "it is convenient to represent" this vector "by a single symbol and to attach a name to it": the chosen symbol and name are **H**, *the magnetic intensity* of the elementary electric field. The relativity transformation of **H** is then found. The resultant **H** at a point, due to several elementary electric fields, is defined as in the case of **E**. It is then possible to infer the field of a moving accelerated point charge, to express it in terms of retarded potentials, and to show that these, with **E** and **H**, satisfy equations "identical with those formulated by Maxwell to describe in analytical form the experimental discoveries of Coulomb, Ampere and Faraday", so that "we can now identify unambiguously the vector **H** with the magnetic force as measured experimentally". Since the equations are linear, they are true also for the field of any number of moving elementary charges. In the next chapter (IV) the analysis is extended to a point charge which has also electric and magnetic moments (the "spinning electron").

The later chapters, which depart less than Chapters III and IV from the usual treatment, discuss material media, energy, stress, momentum and wave motion, radiation and radiating systems, the electromagnetic theory of light, four-dimensional vector analysis and general dynamical methods.

In elementary teaching it seems best to develop the subject in close touch with the few great key experiments; at a later stage some students will wish to see the theory based on a more axiomatic foundation, making contact with experiment only after a series of arguments. This is the task essayed by the authors of this book, and there will doubtless be many teachers who will carefully consider and experimentally use the method of presentation adopted by Profs. Page and Adams.

S. CHAPMAN.

THE ROYAL BOTANIC GARDENS, KEW

CENTENARY AS A GOVERNMENT INSTITUTION

HISTORY OF THE GARDENS

By PROF. F. O. BOWER, F.R.S.

THE origin of the Royal Botanic Gardens at Kew, like that of many other public institutions in Great Britain, may be traced to personal initiative. Though the original site was small, it has been greatly expanded under public guidance and support during the century completed on April 1, 1941. In the eighteenth century a Royal Residence, together with certain houses for accommodation of the Court, clustered about the village of Kew, while a level expanse of alluvial soil on the south bank of the Thames offered a favourable opportunity for horticulture in the relatively pure country air. The methods suggested by Bacon in his essay on gardens were doubtless practised there, and in some degree realized by the ladies of the Court, and in particular by a royal princess. For close to the village lay Kew House and grounds, which were held on lease from 1730 by Frederick, Prince of Wales. It was there that his wife, the Princess Augusta of Saxe-Gotha founded a private botanic garden upon some eleven acres of the enclosed grounds. This first scientific garden of Kew is now merged in the north-easternmost part of the present Royal Gardens. It lies close to the main entrance from Kew Green, and its site is still to-day the intensive centre of the Kew establishment.

The Princess was aided in the foundation and management of that first botanic garden at Kew by the Earl of Bute; also by the architect Sir William Chambers, who designed plant-houses, temples, the Pagoda, and other features of the grounds, after the fashion of the time; some of these are still standing. She was further helped by William Aiton, the author of "Hortus Kewensis", who took charge of the scientific development of the garden. On the death of Princess Augusta in 1772 the property passed into the hands of her son, George III, and it was merged into the adjoining domain of Richmond Lodge. Thus the two properties became united as the oldest part of what is now known as Kew Gardens.

The botanical interest of the garden survived these changes, though its activity slackened. Fortunately, the place of the Earl of Bute as scientific director was taken by Sir Joseph Banks. The date of this change must have coincided nearly with his active participation in organizing Captain Cook's expedition which resulted in the first scientific exploration of Australia and New Zealand. Through him Kew was thus linked closely with botanical enterprise in distant lands. Moreover, its scope was further extended by the dispatch from Kew itself of a succession of collectors. The first of these started in 1772 for the Cape of Good Hope. The collections in the garden were thus enriched from time to time by plants newly discovered or introduced, and the prestige of the garden during a difficult period of transition was for a time upheld.

In 1820 both George III and Sir Joseph Banks died. Thereafter the garden suffered a period of neglect. For twenty years its fate hung in suspense; some even advocated its abolition as a scientific centre. But gradually public opinion began to assert itself. A committee of inquiry was appointed in 1838, with Dr. J. Lindley and Sir Joseph Paxton as its leading members. Their report sketched the ideal of an Imperial Botanical Service of which Kew should be the centre, with establishments elsewhere acting in concert with it. Towards the realization of such an ideal the subsequent development of Kew has ever since aspired, and the high degree of its success is now generally admitted.

In 1840 W. T. Aiton retired. The control of the garden was then transferred from the Lord Steward to the Commissioners of Woods and Forests. It was essential in the first place to secure as director the most able and enterprising botanist available. He was found in the person of Sir William Hooker, regius professor of botany in the University of Glasgow. As a prolific writer on descriptive botany, and as a strenuous director of the growing garden in Glasgow, he was already known throughout the scientific world. These qualifications, together with something of the *grand seigneur* in his personal manner, clearly indicated him as the right man. He took up his duties on April 1, 1841, and this date may be held as marking the birth of the modern Kew. On his arrival, Sir William Hooker found the garden to consist of about eleven acres; but it was in a neglected state; moreover, it was without any residence for the director. There was no museum nor any herbarium or library except his own. All the prime requisites for the scientific conduct of a botanic garden had to be improvised. Nevertheless, in 1841 the garden, hitherto private, was thrown open to the public, and it was visited by more than nine thousand persons in that year.

Thus established as a public institution, Kew Gardens grew like a crystal in a supersaturated solution. What had been lacking was initiative. In 1842 four acres were added, near to the present main gate. and in 1844 the area was increased by forty-one acres taken from the Pleasure Grounds. Two years later fourteen more acres were added. Then the Pleasure Grounds were placed under Sir William's charge, and finally added to the garden, as well as the enclosure surrounding the Queen's Cottage. The result has been that the whole domain of Kew now extends to about 318 acres, all within a ring-fence of simple outline. These extensions of area have been accompanied by the provision of buildings, such as plant-houses, museums, Herbarium and Library. From time to time houses belonging to the Crown, and mostly facing upon Kew Green, have been absorbed for special botanical purposes, or as official residences for the senior members of the staff. Of the plant-houses the greatest is the 1844–48 Palm House built in 1845. The Temperate House was commenced in 1860, but not completed until 1899. There have also been added houses for tropical ferns; a water-lily house, built originally for the *Victoria regia* in 1852, and the so-called T-range where the Victoria water-lily is raised annually from seed. These are examples of the widespread facilities for cultivation under glass. The scientific interest in the living collections really centres in the propagating pits; but these cannot be opened to the public.

The systematic study of plants, as conducted at Kew from dried specimens, concentrates naturally upon the Herbarium, and the various museums. It will be seen in detail later, from the article written by the Director, how Sir William Hooker on his arrival in 1841 brought with him the rich collections which he had accumulated in his private house in Glasgow. But several years elapsed before these found suitable accommodation in the garden at Kew. Eventually they formed the foundations of the present museums, and of the great Herbarium. Each of these departments has been vastly increased by accession of material throughout the century now completed. The Herbarium itself is the focus of the systematic work done at Kew. It has been the source of many classical publications, such as the "Genera Plantarum" of Bentham and Hooker, the "Index Kewensis", the "Flora of British India", and those of the several Dominions and Colonies of the British Empire. Hence issue such serials as the "Icones Plantarum" and the *Kew Bulletin.* Here also much other literary work both of British and foreign origin is being constantly pursued. The building which houses this great "Hortus Siccus" and its magnificent Library originated from a private dwelling-house facing upon Kew Green. It stands on the right as one enters the Main Gate of the Gardens. But the original central block is almost lost among the large additional wings, which have become necessary to accommodate the ever-growing collections of dried plants, and the rich library so necessary for their study.

As in the animal body the co-ordinating brain is hidden away and protected in the skull, so in Kew the Director's office is protected from the public eye. In a quiet backwater, shut off from the constant stream of visitors, there is an inconspicuous brick building, not beautiful or antique, towards which the imperial interests in botany converge. Here is the centre of administration of the Gardens with its numerous staff, while from it radiates information and advice not only for those at home, but also to the Dominions and Colonies—and to foreign lands as well; for there is an international freemasonry in science, which even war does not wholly paralyse.

Teaching, as such, is not undertaken in the Royal Gardens, though demonstration of living plants is encouraged there, while instruction deemed suitable is given to the student gardeners in training. But research has always been actively aided there, whether it be pursued by the staff or by accredited members of the public. Naturally, systematic work on dried plants is readily enough carried out in the Herbarium. But morphological or physiological research requires such accommodation as a specially designed laboratory alone could afford. The need for this became urgent as the revival of the study of those branches of the science took effect in the seventies of the last century. Through the munificence of Mr. J. Phillips Jodrell a research laboratory was built and presented by him to the Gardens in 1875. It is a small block of red brick and stone, placed in the north-eastern corner of the Gardens, close to the office-yard and propagating pits. Tyndall and Burdon Sanderson were among the earliest to use so convenient a place for research on living plants, and they have been followed by many others. In particular, some of the initial experiments leading towards the manufacture of artificial silk were carried out there—also certain remarkable experiments on the control of gaseous interchange in sub-aerial plants. Sustained inquiries on fossil plants of the Coal Period were also conducted there by Williamson and Scott, the latter having acted for many years as honorary keeper of the Laboratory. These are merely examples of work which has been done in the Jodrell Laboratory by the long sequence of botanists who have used it. Their results have proved the value of this late adjunct to the Royal Gardens.

Nothing has marked the recent decades of botanical research more clearly than the advance of preventive practice against plant diseases, and especially those of fungal origin. Such work under Government subvention has been centred in the Imperial Bureau of Mycology. This is at present located at Kew, in a building in close juxtaposition with the Herbarium, though the autonomy of the Bureau is still preserved. Nevertheless, in spirit and in purpose it may be held as part of the establishment at Kew, helping to round off its activities which at the first were relatively simple, but have naturally expanded as the century of its existence passed, and the science itself advanced.

This brief sketch of the origin and evolution of the establishment known as the Royal Botanic Gardens at Kew during the first century of its existence will commend it as an institution worthy of the highest esteem by the public which it serves. For its purpose is not merely as a place of joyful recreation for holiday crowds, but also as one of the most striking and least costly exponents of scientific enterprise within the British Empire.

KEW IN RECENT YEARS

By Sir Arthur Hill, K.C.M.G., F.R.S.

The foundations so well and truly laid by Sir William Hooker to make the Royal Gardens at Kew a botanic garden worthy of the nation, as a place of education, healthful recreation and research, have nobly stood the test of time, and now after a hundred years, though the War, alas, has sadly curtailed normal activities, the Royal Botanic Gardens are carrying on the various lines of wo[illegible] they were envisaged by Sir Willi[illegible] Other import[illegible] Sir Joseph Hooker and thei[illegible]cal, metallurgical and [illegible] them, indeed, can be traced back to the great days of Sir Joseph Banks and George III.

The general plan and functions of the Gardens have altered only in detail; additions have been made and the general amenities and beauty of the Gardens have been improved, despite the increase of London smoke and fog and its deleterious effect on vegetation and especially on coniferous trees. So much have these been affected that it has been necessary to establish a National Pinetum at Bedgebury in Kent, so that the conifers may develop to the best advantage. This joint effort of Kew and the Forestry Commission comes under the direction of Kew.

Other improvements in recent years include the addition of Cambridge Cottage and its garden, with the formation of the Museum for the display of British timbers and the products derived from them, photographs and specimens of the trees and exhibits of the fungus and other diseases to which trees are liable. By the side of the Museum medicinal plants have been planted in a series of beds around the sundial made and presented by Sir Charles V. Boys, arranged on the plan of the botanical garden at Pisa.

The Rock Garden has been considerably enlarged at its northern end by the formation of an 'island' of Sussex sandstone almost surrounded by a stream, and two new entrances have been constructed at the northern end. The water garden, in front of Museum II, based on the design of the sunk garden at Hampton Court, with raised tanks which enable the plants to be studied with ease, has proved a considerable attraction and a very desirable addition to the Gardens. The Alpine House, the original one being the first of its kind to be erected, was entirely rebuilt and enlarged in 1938.

From the general educational point of view attention should be directed to the planting out of the tree ferns in the Tropical Fern House, and the arrangement of the epiphytic ferns and other epiphytes on tree trunks, etc., as they grow in their native forests. The stag's-horn ferns (Platycerium) in the centre of the House, growing on tree trunks, make a particularly fine and realistic display. Attention may also be directed to the houses devoted to the fine collection of pitcher plants, insectivorous plants and Cape Pelargoniums, the two latter having been constructed when the Economic Houses were rebuilt and much enlarged in 1930.

The gift of Mrs. Sherman Hoyt of the new Cactus House, with its painted background of the Mohave Desert, California, has enabled the public to appreciate the way these plants grow in their natural habitat—the foreground being built up with blocks of old red sandstone so closely harmonizing

MINERAL RESOURCES OF CONTINENTAL EUROPE

BY DR. W. J. ARKELL

WHAT exactly are the mineral resources of the German Old Reich, and what does she stand to gain from the resources of her allies and her conquests? What attractions are offered by the remaining neutral countries of Europe? What minerals deficient in Europe can be supplied by the U.S.S.R.? There appears to be no up-to-date account of this important subject in the English language.

In the following synopsis Continental Europe is understood to mean Europe less the British Isles, Spitsbergen, Turkey and Russia.

Only minerals of strategic importance are dealt with. They may be grouped as follows:

(1) Fuels: oil and coal.

(2) Major metals: iron, copper, lead, zinc, tin.

(3) Steel alloy metals: manganese, chromium, nickel, cobalt, tungsten, molybdenum, vanadium, zirconium, titanium.

(4) Other metals: aluminium, magnesium, mercury, antimony, arsenic, uranium, platinum.

(5) Fertilizers: phosphates and potash; also [illegible]rites, needed for the manufacture of super-[illegible]

[illegible]ant non-metals, used in the [illegible] industries (mica, [illegible]

of lignite, which is 36 per cent of the world's total production, although Europe has only 2 per cent of the world's reserves.

Iron: Germany possessed 17 per cent of the European reserves of metallic iron, but her ores are mainly low-grade and therefore extravagant to work. For her immense steel industry she was mainly dependent on imports.

Copper. In the Mansfeld stratified deposit Germany possesses the most important copper occurrence in Central Europe, and with more than 20 per cent she had the highest copper production of any European country after Yugoslavia. But the total European production being only 6·3 per cent of the world production and the reserves (including huge deposits in Spain) only 10 per cent of world reserves, the total amount of copper is inadequate for the highly developed electrical industry. It is being increased by developing newly discovered low-grade ores in Silesia and eastern Hessen. The latter field is said to be perhaps as important as Mansfeld itself.

Zinc and Lead. In her share of Upper Silesia, Germany possessed about 15 per cent of the richest zinc and lead deposits in Europe, the rest belonging to Poland. These and numerous other deposits in different parts of the country gave [illegible]erves of about 7·4 million tons of [illegible] million tons of recover-[illegible] and 29 per cent she [illegible] with the rocks of the painted background that the two pass almost imperceptibly one into the other.

The adjoining house, devoted to the succulent vegetation of South Africa, planted among triassic rocks and quartzite which exactly match the Karroo formation, was a gift to Kew in commemoration of the Silver Jubilee of King George V, and is of great educational value. The button-like Mesembryanthemums growing, as in Nature, among conglomerate rocks, are only distinguishable with difficulty from the pebbles in the conglomerate.

Among the trees and shrubs many additions have been made, thanks to recent explorations in China, Thibet and Chile, which not only have fully utilized all the available ground in the Gardens, but have also necessitated the building of an annexe to the Temperate House for the tender Rhododendrons.

Much has also been done to improve the pits and other houses in the private parts of the Gardens where the plants are propagated and grown for distribution to the Colonies and for display. A house next to the Orchid Houses has also been set aside for the display of plants of particular interest and for the exhibition of the history of well-known plants, such as Primulas, 'Geraniums' and plants of special biological interest, while during the summer certain beds are devoted to the cultivation of annual plants according to their countries of origin, so that the public may learn whence some of the plants now commonly grown in gardens are derived.

Turning to the more scientific side of the Gardens' activities—exhibits of interest are arranged from time to time in th
illustrate matters of part
while in the Herb

be mentioned "The Flora of West Tropical Africa", 2 vols. with the "Useful Plants of West Tropical Africa" as an appendix volume of 612 pages; "The Cultivated Crop Plants of the British Empire"; the completion of the "Flora Capensis"; and the continuation of the "Flora of Tropical Africa".

Among the more recent plant introductions to the Colonies, that of tung oil (Aleurites) should prove of importance. Kew is also assisting in the effort to combat the Panama disease of bananas by collecting bananas from various sources and growing them in a specially built Quarantine House before dispatching offsets free from diseases to the Imperial College of Tropical Agriculture, Trinidad, for cross-breeding experiments. Similar assistance is being given to Trinidad, Nigeria and the Gold Coast in connexion with the witch-broom and other diseases of cacao, and to the Researc
Institute, Amani, in connexion with mosaic diseas
of Cassava.

The Royal Botanic Gardens, Kew, theref
after a hundred years are still engaged in fur
ing every kind of botanical enterprise that ma
of assistance to the Empire, and in training a
of student gardeners to carry out the scienc
practice of horticulture both at home and ov
besides affording pleasure to thousands
visitors.

The following passage from the Book "
asticus" might well be applied to Kew, when i
remembered that Sir William Hooker, when
became director on April 1, 1841, had a garden
only eleven acres without any
or laboratory buildings

Nickel. Although recent production of nickel ore in Germany has been very small (268 tons was the greatest amount in any year from 1935 to 1938), there are a number of deposits, and production can be increased about four-hundred-fold in times of stress. The output reached 102,000 tons in 1917. This represents about 2,050 tons of nickel, or 73 per cent of the total maximum annual European production for the years 1935–37, and 30 per cent of Germany's imports of nickel in the normal peace-time year 1936.

Molybdenum. About 40–50 tons of molybdenum a year can be produced as a by-product from the Mansfeld copper ores, but this is not 8 per cent of the European production, which in turn is only about 4 per cent of world production.

Vanadium. Germany's normal consumption of about 250 tons of vanadium is capable of being met by concentration of small traces which occur in the iron ores from Baden, Lorraine and Sweden, smelted in Germany.

Tungsten, Cobalt and Titanium are virtually absent.

Aluminium. Production of aluminium from Germany's negligible deposits of bauxite, if extended to the maximum, could scarcely amount to 2 per cent of her imports in recent years. On the other hand, the Germans have brought to a high state of efficiency processes for the production of aluminium from clays, kaolins and low-grade ores.

Magnesium. In Silesia there are small but pure deposits of magnesite, and the carnallite of the Stassfurt salt deposits yields 5·5 per cent of magnesium and has been extensively used as a raw material. Statistics are not available.

Mercury. Recent intensive exploitation of home supplies of cinnabar are believed to produce 200–300 tons of mercury a year, or about 30 per cent of the recent average German consumption. (This would represent about 6 per cent of the total European production and about 5 per cent of world production.)

Antimony. Germany has produced as much as 700 tons of metallic antimony in a year, which is equal to about 20 per cent of her consumption in recent years.

Arsenic. There are extensive deposits in Silesia, and as much as 4,600 tons of white arsenic have been produced in a year (1930), and as much as 2,800 tons have been exported recently in a year (1938).

Phosphates. Like many countries, Germany has various low-grade phosphatic rocks which can be drawn upon in time of war, but are scarcely worth working in peace-time. Also she has enormous reserves of phosphatic iron ores which, when smelted by the Thomas process, yield good basic slag. But of true high-grade phosphate deposits she has scarcely any.

Pyrites. Germany has twice as much pyrites as any other European country except Spain. The reserves amount to about 100 million tons, or 13 per cent of the known world reserves. In 1918 the production reached nearly 1 million tons a year, and it should be possible to exceed that now.

Sulphur. Nearly a quarter of a million tons of sulphur a year can be produced as a by-product of coal, coke and barytes industries, and during lead, zinc and copper mining. The actual amount produced hitherto in a year is probably more like half this figure.

Potash. Central Germany contains 80 per cent of Europe's deposits of potash, which are 96 per cent of the world's total reserves (less uncertain deposits in Russia). Her production in 1937 was 73 per cent of the European production and 62 per cent of world production.

Mica, Talc and Asbestos are almost entirely lacking in Germany; *diamond* does not occur in Europe.

Graphite. Germany leads European production. The deposits are extensive and easily accessible, and the output has reached 40,300 tons in a single year (1918). This would be 56 per cent of the European production if it had been repeated in 1937, and nearly 19 per cent of the world's total in recent years, as compared with 7 per cent in the British Empire and less than 4 per cent in the United States.

Fluorspar. In this Germany has a still more commanding position—a matter of importance in view of its great value in the steel industry. Her production is more than 68 per cent of the total European production and nearly 33 per cent of the world's total (as compared with 10·7 per cent in the British Empire).

AUSTRIA

Magnesium. The outstanding gain to the Reich war machine in taking over Austria was the acquisition of the world's largest and purest deposits of magnesite for the making of magnesium for incendiary bombs, flares, and aircraft. For years Austria headed the world's production and has only recently been just outstripped by Russia.

Other metals. Minor assets are small quantities of iron, lead and antimony (more than double Germany's production of antimony has been reached).

Talc. Austria's production of 16·7 per cent of the European total is four times as great as Germany's, and satisfies a need.

Graphite. Austria's graphite deposits are second only to Germany's. The two together give Germany a commanding position with a production of more than 40,000 tons a year, or 74 per cent of the European production in 1937, and potentialities for producing more than 60,000 tons a year, as was done during the War of 1914–18 (28 per cent of the present-day world's total).

CZECHOSLOVAKIA

Lignite. The Sudetenland contains a reserve of 11½ million tons of lignites of a quality far superior to those of Germany; they represent about 12 per cent of the European reserves.

Asbestos. With 15 per cent of the European production this will be a welcome asset, since Germany and Austria possess practically none.

Graphite. The graphite deposits of Bohemia and Moravia are among the most valuable in Europe, and production exceeded 41,000 tons in 1927—equal to Germany's maximum production during the War of 1914–18. This extra acquisition gives Germany practically a monopoly of European graphite.

Uranium. Bohemia contains by far the most important uranium deposits in Europe, practically the only others being in Portugal. For many years she led the world's production.

Antimony. Czechoslovakia accounted for 30 per cent of Europe's antimony production in 1937.

POLAND

Oil. Poland produced more than half a million tons of oil a year. The Germans and Russians took over the industry in full working order. The German share represented a production of only about 150,000 tons a year, but this is capable of substantial increase, and is a clear gain to Germany. It is considered probable that the oil from the Russian part of the field will also go to Germany.

Coal. The Dombrova and Ostrawa-Karwina coalfields made Poland the third largest coal-producing country in continental Europe, with 11 per cent of the output and 28 per cent of the reserves. She also has lignite reserves larger than those of Czechoslovakia and almost entirely undeveloped.

Zinc. Polish Upper Silesia contains a continuation of the German Silesian zinc and lead ores. The output of zinc in 1937 was 15·6 per cent of the European production, and added to the German production it gives her more than 50 per cent of the total European production and about 12 per cent of world production. This is sufficient for German requirements of zinc in all circumstances.

NORWAY

The commodities that Norway can furnish are just those which Germany needed most, namely, the steel alloy metals and helpful quantities of copper and mica for the electrical industries.

Copper. The addition of the Norwegian copper production to the German represented an increase of 66 per cent, and the Norwegian output is capable of being stimulated.

Nickel. In 1917 Norway produced 78,000 tons of nickel ore, representing about 780 tons of metallic nickel, and there is no reason why this figure should not be exceeded under German direction if necessary.

Molybdenum. At present Norway is believed to be producing about 750 tons of molybdenite a year, representing about 450 tons of metallic molybdenum. It is the only important producing country in Europe.

Titanium. The Norwegian deposits of ilmenite and rutile are the largest in the world, and would suffice to furnish the world's supply of titanium for centuries. One quarter of the world's production came from Norway.

Chromium. In 1918 nearly 7,000 tons of chromite were produced. This is only a small amount, but it is valuable to Germany in the absence of other supplies.

Mica and Talc. In 1938 Norway produced more than 100 tons of sheet mica and probably at least 30,000 tons of talc. With Austria, this gives Germany 37 per cent of the European talc production and 27 per cent of the mica production.

LUXEMBURG, BELGIUM, HOLLAND, DENMARK

Iron. The only gain of real consequence accruing to Germany's mineral resources as the result of the invasion of these countries is the iron ore of Luxemburg. Although the production is only 7·2 per cent of the European total in terms of iron content, it is almost as great as Germany's own, and it is conveniently situated near the German western industrial districts and coal supplies. The amount produced in 1937 was nearly 2¼ million tons of metallic iron.

FRANCE

Iron. France has by far the largest reserves of iron in Europe, situated mainly in Lorraine. In terms of metallic iron they represent 47 per cent of the total European reserves, and the production in 1937 was 41·5 per cent of the European and 15·3 per cent of the world production.

Aluminium. The largest quantity of bauxite was also produced in France (32 per cent of European production) and the reserves are by far the largest in western Europe. In 1937 the production of bauxite in France was 18 per cent of the world's total, as compared with 10·7 per cent in the British Empire and 11·2 per cent in the United States.

Coal. France has the second largest coal production after Germany. The total production of Germany, France, Poland, Belgium and Holland represents practically 100 per cent of the European output, which is substantially greater than that of the British Empire, though the reserves of hard coal are only two-thirds as great as those of the Empire and the lignite reserves only one ninth as great.

Fertilizers. More than 70 per cent of the European production of phosphate rock came from France, and she holds about 36 per cent of the reserves. Alsace also contains the only considerable deposit of potash outside central Germany. The two together give Germany a monopoly with more than 90 per cent of the European reserves and production, and nearly 90 per cent of the whole world's potash reserve ; though Russians have recently claimed to possess a still greater reserve.

Talc. France has the largest production of talc in Europe (31 per cent), and is the third largest producer in the world, after the United States and Manchuria. In 1937 and 1938 her exports alone substantially exceeded Germany's imports.

Fluorspar. Germany has a sufficiency of this mineral in her own territory, but the French production, although little more than a third as great as the German, is still in excess of that of the whole British Empire. Germany and France together produce about the same amount as the British Empire and United States combined.

ITALY

Italy lacks oil, coal, lignite, iron, copper, and most of the ferro-alloy metals. To this extent she is a heavy liability to the Central European war machine. For example, her civil consumption alone of oil and oil products was 3 million tons in 1938 and again in 1939, of which only 220,000 tons each year were supplied by Italy and Albania. This is not counting the heavy war consumption for her fleet, air force and mechanized columns in Africa. Therefore so soon as stocks are exhausted she will compete with Germany for Rumanian oil. The same applies to nearly all the indispensable metals.

There is, however, another side to the picture. Many of the other minerals are plentiful in Italy, and in at least two of them, mercury and sulphur, she easily heads the world's production. These and several of the other minerals produced by Italy happen to be scarce in Germany—especially bauxite, lead, and asbestos. In exchange for them Germany finds a market for some of her superabundance of coal and potash.

Sulphur. The Sicilian sulphur belt is by far the most important deposit of native sulphur in Europe, if not in the world. Italy accounts for 80 per cent of the European production.

Pyrites. Italy also has the third largest pyrites production in Europe.

Mercury. The cinnabar deposits of Idria (formerly in Austria) make Italy the world's leading producer of mercury. The only other large-scale European deposits are in Spain.

Zinc and Lead. In 1937 Italy accounted for 16 per cent of the European zinc production and 13 per cent of the lead. The mines are mainly in Sardinia. Her average production over a number of years has been maintained at more than 77,000 tons of metallic zinc and more than 25,000 tons of metallic lead annually.

Manganese. Italy takes third place with 19 per cent of the European production of metallic manganese from high-grade ores, and it is believed that she is self-sufficient in this metal.

Aluminium. Italy also takes third place in the production of bauxite, with 18 per cent of the European total. Her reserves, however, are relatively small.

Antimony. Production is sporadic ; but in 1937 Italy occupied third place with 14·6 per cent of the European production.

Mica. In 1938 Italy occupied second place among European countries producing mica, the order being: Sweden with 129 tons, Italy with 120 tons, Norway with 102 tons, and Rumania with 22 tons.

Asbestos. Italy is a close second after Finland in the production of asbestos ; but although she produces 39 per cent of the European total the amount is small, since Europe's production is only 3 per cent of the world's total. The Italian production is only equivalent to about a quarter of Germany's imports.

(*To be continued.*)

OBITUARIES

Sir George Grierson, O.M., K.C.I.E.

SIR GEORGE GRIERSON, who died at Camberley on March 7 at the age of ninety, was the most distinguished of the select group of Indian officials who carried out invaluable philological, ethnographic or historical studies in addition to their official duties.

Before entering the Indian Civil Service in 1873, Grierson had already acquired an exceptional knowledge of Sanskrit and Hindustani. His early service was spent mainly in Bihar, where he made an intensive study of the local vernaculars. When he had been only ten years in the country, he published his "Seven Grammars of the Dialects and Sub-Dialects of the Bihari Language".

Grierson was nominated by the Government of India as its representative at the Congress of Orientalists held at Vienna in 1886. At this Congress, a resolution was passed urging the Government of India to undertake a linguistic survey. Some years elapsed before anything was done, but in 1894 it was decided to accept the suggestion, and Grierson was appointed superintendent of the Linguistic Survey of India. His first step was to obtain from each district a list of all the languages and dialects spoken in it, together with uniform specimens of each. The preparation of these specimens, in the case of the lesser known languages, had often to be entrusted to persons of inferior education, and they had to be subjected to most thorough scrutiny and revision before they could be accepted as correct. This preliminary operation lasted four or five years. The processes of digesting and collating the raw material thus provided necessarily took much longer. Each specimen had to be subjected to close analytical study in order to ascertain its grammatical structure and other peculiarities, and to decide whether it should rank as an independent language or a dialect, and to what linguistic family it should be assigned. The final stage was the preparation of a classified scheme of linguistic families, sub-families, languages and dialects, and the arrangement, editing and annotation of the specimens.

The "Introductory Volume" in which the final results were reviewed, was not published until 1927, thirty-three years after the inception of the work. The enormous labour involved will be understood when it is noted that, in all, 179 languages and 544 dialects have been recognized, and that the report extends over twenty bulky quarto volumes.

Many of the principal languages were, of course, already well known, and had been the subject of investigation by a number of scholars, notably Caldwell, Beames, Max Müller and Hoernlé. But even in their case, Grierson was able to establish new conclusions, including the differentiation of "Hindi" into three distinct languages, and the recognition of Lahnda as an independent language and not a mere dialect of Panjabi.

Among the lesser-known vernaculars he made an intensive study of Kashmiri and other Pisacha languages. Of the 132 Tibeto-Chinese languages examined, grammars and vocabularies had already been compiled only for about twenty; most of the others had never previously been reduced to writing.

The Linguistic Survey of India represents an unparalleled achievement. It has been universally recognized as such, and learned societies and universities in many different countries have vied with each other in showering distinctions upon the man responsible for it. Grierson's final honour was the O.M., which was conferred on him in 1928.

Grierson was the author of other books, too numerous to mention in a brief review, and of many papers in the journals of Oriental societies. Although languages were always his main preoccupation, his interests covered a very wide field. For example, his "Bihar Peasant Life" has been described as "an encyclopædia of information about the people of Bihar". He was for many years the mainstay of the Asiatic Society of Bengal and afterwards a leading member of the Royal Asiatic Society.

Apart from his great attainments and industry, Grierson's most marked characteristic was the unselfish assistance which he was always ready to give to other workers, however humble. I, myself, gratefully remember the trouble that he took, though I was then a stranger to him, in making my first contribution suitable for publication in the journal of a learned society. At the Census of India in 1901, and again in 1911, Grierson freely placed all the facts which he had until then ascertained at the disposal of the Census officers, so that they could utilize it in their reports, before he had himself published it. He gave immense help to the Bible Society in the preparation of vernacular versions of various parts of the Bible. E. A. GAIT.

Dr. A. T. Masterman, F.R.S.

THE late Dr. A. T. Masterman was superintendent inspector of fisheries to the Board of Agriculture in 1910, when the Board took over the international fishery work of the Marine Biological Association. From then onwards Masterman directed the scientific fishery work of the Board, but his interest in the commercial possibilities of various scientific discoveries culminated in his relinquishing his post to engage in business enterprises. On the resumption of the scientific fishery work in 1920, the task of reorganization fell to Prof. Stanley Gardiner.

During his administration of the scientific branch of the Fisheries Department, Masterman found time to write three papers on the age and growth of various fresh- and brackish-water fish, all of which showed a balanced critical view of the technique, and among which his paper on the salmon of the Wye should be known to all interested in salmon. He kept a large staff of scale-readers busy. He published also several important papers on the plaice fisheries of the North Sea.

In pure zoology Masterman will be remembered for his attempt in 1896–1901 to place the burrowing worm-like animal Phoronis near Balanoglossus and the vertebrate ancestry. The evidence came from the internal anatomy of the larva (Actinotrocha). This thesis was contested by many, including Roule, to whom Masterman replied with dash and vigour, but in 1904 de Selys Longchamps claimed to remove Masterman's edifice stone by stone. Ikeda, Goodrich and Shearer all disagreed with Masterman on one point or another. Although in 1910 Harmer in the Cambridge Natural History, put Phoronis in the Hemichordata on the basis of Masterman's observations, 'if confirmed', MacBride in 1914 in his "Text-book of Embryology" feared that Masterman's "fascinating" theory could not be upheld and put Phoronis with Sipunculus in Podaxonia (*Gephyrea nuda*). In the 1921 (revised) edition of Parker and Haswell's text-book Phoronis remains with the Brachiopoda and Polyzoa under Molluscoida. However it ended, Masterman's initiative evidently led to substantial additions in knowledge of Phoronis and its interesting larva.

Masterman was seventy-two years old when he died on February 10, but, as may happen when reviewing the work of scientific workers who reached administrative posts early in life, the search for the man's own work is most productive when we go to the early years, in Masterman's case to the time when he was less than thirty years old. From 1893 until 1899 he was assistant to Prof. W. C. McIntosh at St. Andrews, and collaborated in a book that can be called a masterpiece, "The Life Histories of the British Marine Food Fishes", published in 1897. The only part of the book that is stated to be Masterman's separate contribution is a general chapter on growth, and this must be judged against its background, when almost nothing was known on the subject except for the papers which this young investigator had already published. The chapter, which is an essay, undoubtedly had considerable value forty-four years ago, when nothing was known of the technical methods that have been so fruitful in the intervening years, and the graphical method that Masterman used is still the only one available for some populations of fish. The main bulk of the book is stated to be joint work. It consists of notes on life-histories of no less than eighty-seven species of fish—a remarkable treatise to have been produced only a few years after the eggs and fry of many of the species had first been identified. To collaborate in that work was a worthy achievement.

Indeed, Masterman at St. Andrews was a member of a notable company who studied at the Gatty Laboratory and went out to make marine biology as we know it. Some of us who only knew the members as men of middle age and older, wonder what the company was like; but are certain that it was both gay and learned, for it included, at one time or another, Holt, Prince, Kyle, Williamson, Calderwood, Wallace, Meek, and D'Arcy Thompson. To them Masterman, scholar of Christ's and Darwin Prizeman, brought the speculative turn of mind that is shown by his papers and the gift of lively companionship that his contemporaries recall.

M. GRAHAM.

Dr. William Doberck

WILLIAM DOBERCK was born at Copenhagen on September 12, 1852, and died at Sutton, Surrey, on January 5 of the present year. He had long been well known as one of the most enthusiastic and assiduous of workers in the field of double-star astronomy.

Dr. Doberck began his observations at Markree, Ireland, in 1874, at the observatory of Col. E. H. Cooper, at that time H.M. Lieutenant for County Sligo; but later worked in various parts of the world, including Kowloon. Eventually he settled at Sutton, where he set up an observatory equipped with a 6-in. refractor and continued his double-star measurements until 1927. His sets of measures, which were very numerous, amounting altogether to something like 13,000, were nearly all made with rather small instruments, but included several pairs of which the angular separation was less than 1″. The observations at Markree were published in the *Transactions of the Royal Irish Academy*, vol. 29, part 13, and the remainder in various issues of the *Astronomische Nachrichten*. Eventually, Dr. Doberck collected them all together and published them in vol. 7 of the *Astronomische Abhandlungen*.

But Dr. Doberck was not only an observer; he was also a computer of orbits. In his book "The Binary Stars", published in 1918, Dr. R. G. Aitken referred to him as "the man who has investigated more double-star orbits than any other astronomer". Doberck also inquired into other problems relating to binaries, such as a possible parallelism of the orbit planes, in regard to which his investigation led him to a negative conclusion. He also at one time gave attention to variable stars. It is as an exceptionally diligent and successful student of visual double stars that he will always be remembered.

T. E. R. PHILLIPS.

WE regret to announce the following deaths:

Dr. E. J. Gwynn, formerly provost of Trinity College, Dublin, on February 10.

Dr. P. N. Leech, director of the Division of Foods, Drugs and Physical Therapy in the headquarters office of the American Medical Association, aged fifty-two.

Sir William Smyly, formerly master of the Rotunda Hospital, Dublin, and president of the Royal College of Physicians in Ireland, on March 19, aged ninety.

Dr. Michel Weinberg, of the Pasteur Institute, Paris, known for his work on parasitology and anærobic bacteria.

NEWS AND VIEWS

Guthrie Lecture of the Physical Society

PROF. E. N. DA C. ANDRADE, Quain professor of physics in the University of London, is delivering the twenty-fifth Guthrie Lecture at a meeting of the Physical Society in the Royal Institution on April 4. The lecture is entitled "A Problem of Guthrie's Time" and its subject is sensitive flames, or rather sensitive jets in general, one of the types of acoustical investigation so elegantly and so successfully carried out by Prof. Andrade and his students at University College, London. It was at that college that Andrade started his research career. From there he went to Heidelberg to work under Lenard on the electrical properties of flames; for this work, in which he established, for the first time, the true velocity of the positive ions, he obtained his Ph.D. *summa cum lauda*. Returning for a further year to his old college, of which he became a fellow, he established the laws of the flow of metals under constant stress, and prepared the first single crystals of certain metals, including solid mercury. He then went to the Cavendish Laboratory for a year, and afterwards to Manchester, where he carried out, with Rutherford, the first determination of wave-lengths in the gamma-ray spectrum. During the War of 1914–18, Prof. Andrade saw active service in the R.G.A., and was mentioned in dispatches. Afterwards, he was appointed professor of physics in what was soon to become the Military College of Science, Woolwich, where he built up a physics department *ab initio*, put the teaching of physics on a sound footing, and did everything that was possible to foster active experimental research in his department.

In 1928 Prof. Andrade was appointed to the Quain chair of physics at University College, where he resumed work on single crystals and established a flourishing school of research. Here, too, he has done fundamental work on liquid viscosity and on acoustics, including investigations on Kundt's tube in the most general aspect, and also on sensitive jets, which form the subject of his Guthrie Lecture. Every item of his experimental work displays the marks of extreme thoroughness and great beauty. Prof. Andrade is widely known as a brilliant exponent and an original popular lecturer. His books have the same excellent qualities as his researches and his lectures; among them are "The Structure of the Atom", which very quickly reached a third edition, "The Atom" (a smaller book), "Engines", and "The Mechanism of Nature" (which has been translated into six European languages). In addition to his scientific work, he has found time to maintain his old activities and interests in poetry, and as a collector of old books.

Iron and Steel Institute: Bessemer Gold Medal

DR. THOMAS SWINDEN, who has been awarded the Bessemer Gold Medal for 1941 of the Iron and Steel Institute, is director of research in the United Steel Companies, and a director of Messrs. Samuel Fox and Co. Ltd. He studied metallurgy at Sheffield under Prof. Arnold, being awarded the Mappin Medal and gaining an 1851 Exhibition scholarship, with which he went to Sweden, working in the University of Uppsala and in Swedish steel works. Returning to England he entered the firm of Samuel Fox and Co. at Stocksbridge, near Sheffield, where he installed a laboratory for physical testing. When the firm became part of the United Steel Companies, Dr. Swinden took charge of the research work of the combined firms, and in 1934 the exceptionally well-equipped Central Research Department at Stocksbridge was opened. By the organization and staffing of this laboratory, he has done much to advance the application of science to the iron and steel industry.

Dr. Swinden's own investigations have included the first detailed study of the tungsten steels, carried out partly at Sheffield and partly at Uppsala. This laid the foundation for all later work on tungsten steels, and was followed by a similar exhaustive study of molybdenum steels, for which he was awarded the Carnegie Gold Medal of the Iron and Steel Institute. His later work has dealt with the properties of cold-rolled steel and with the control of grain size in steel. As chairman or vice-chairman of research committees, he has rendered valuable service in connexion with researches now in progress, especially on the problem of oxygen in steel and on the improvement of refractory materials.

University of Bristol: Chair of Anatomy

PROF. S. E. WHITNALL has retired from the chair of anatomy in the University of Bristol on reaching the retiring age. His going will be a loss to British anatomy in many ways, for he was far more than an anatomist. He was a contributor to the columns of *Punch*, and the author of that most human little publication "The Study of Anatomy". Had Prof. Whitnall never made any other contribution to the study of anatomy, that publication would have endeared him to many. To his contemporaries he will ever be remembered as the most humorous and human of companions; to the present generation he may be no more than the respected author of the "Anatomy of the Human Orbit". But despite the attack of the B.N.A. on eponymous nomenclature, he may claim in 'Whitnall's tubercle' to be the only living anatomist whose name remains attached to a definite structure in the human body. His last rival in this regard was the late C. B. Lockwood of St. Bartholomew's. Prof. Whitnall hails from Lancashire and he entered Owens College in 1894. Afterwards he was associated with St. Thomas's and for long with Oxford. In 1919, after war service with the Oxford Hussars, he went as professor of anatomy to McGill University, Montreal. There he remained until 1934, when he took the chair at Bristol, from which he is now retiring.

Dr. J. M. Yoffey has been appointed to succeed Prof. Whitnall in the chair of anatomy in the University of Bristol. Like his predecessor, Yoffey is a Manchester man, qualifying from the University of Manchester in 1926. Dr. Yoffey has had a brilliant career both as a student in Manchester and as a teacher at University College, Cardiff. More than this, he has had the great advantage of a Rockefeller Scholarship, which enabled him to carry on his researches in the United States in association with Prof. Drinker. As a research man Yoffey's name is permanently associated with the problems of lymphatics and lymphatic pathways. In this realm he has won wide recognition by reason of the thoroughness and the accuracy of his methods. When, in the post-War period, the Anatomical School of Bristol is reconstructed, we may look to see it as the centre of active investigation and research, and as the department to which many will go for inspiration and for knowledge of one of the most important subjects in which human anatomy impinges on clinical investigation.

Marine Biological Association's Laboratory: Air Raid Damage

DURING the recent air-raids on Plymouth, the Laboratory of the Marine Biological Association suffered severely. The buildings, though still standing, have sustained heavy damage. All windows except a few on the south side of the top floor of the main building have gone; ceilings are down, doors wrenched off, and much structural damage caused by blast. The director's house was completely burnt out. The Library, very fortunately, is intact except for the loss of windows and the skylight, and it has now been made waterproof. At the eastern end of the north building damage is most severe, but the greater part of the equipment and apparatus is intact. The Easter-class house will no doubt have to be rebuilt, but most of the roof remains. Other outbuildings, including the dogfish house, director's garage and stores, and the constant temperature rooms, have all sustained damage. The exact extent of the structural damage to the buildings cannot be determined without expert assistance, but it is hoped that the laboratories themselves can be restored. The tanks on the north side of the Aquarium burst and the supply pipes broke, but it is hoped that some part of the circulation may be restored before very long.

It will evidently be a long time before permanent repairs can be undertaken. Since materials for urgent work are extremely short, the cellotex sheeting on the first and second floors of the main laboratory is being taken down and used to replace windows. It is hoped to fit a small glass pane in each room, and if the cellotex is well painted, it is expected to remain weatherproof for a year or two. In a few weeks it may be possible to accommodate research workers who require only limited facilities, but this must depend largely upon the restoration of electricity and water supplies. There is no difficulty concerning general administration, as most documents have been salved. For the time being it will not be possible to supply orders for specimens, but it is hoped that in the course of a few weeks some of the normal facilities will be available.

University of Glasgow: Air Raid Damage

WHILE the University of Glasgow has as yet received no direct hit during recent air raids, all the windows of the main University buildings facing the park have been shattered. The Departments of Physiology, Public Health and Zoology have lost most of their windows, while many window frames and ceilings have been damaged. Some of the class rooms are temporarily unusable. Fortunately the damage to the contents of the buildings is quite negligible, and none of the personnel, staff or students, was injured although there were fire patrols in all the buildings. No other scientific institution in Glasgow appears to have been damaged.

City Museum, Leeds: Air Raid Damage

DURING recent air raids, the City Museum at Leeds suffered. The principal damage was done to the bird room and to the collections of medals and local tokens. Cases containing geological, archæological and zoological exhibits suffered from blast, but their contents are intact. Generally speaking, a large percentage of the disturbed material can be recovered. A collection of birds eggs survived a fall of 20 feet.

Annals of the Botanic Gardens, Buitenzorg

UNTIL recently the *Annales du Jardin botanique de Buitenzorg* were published at Leyden. As the European territory of the kingdom of the Netherlands is now occupied by the Germans, a new series under the title of *Annals of the Botanic Gardens, Buitenzorg*, has been started at Java. This periodical will cover the whole field of pure botany, including plant physiology, morphology, anatomy, cytology, ecology and microbiology. It will contain contributions by the regular staff and visitors of the scientific institutes of the Botanic Gardens, as well as from other sources. The editors mailing list is, however, not available in Java. As it is intended to continue exchange as usual, it is necessary to renew or confirm each exchange. The same holds for subscriptions to the new series. The price per volume is fixed at fl. 10. Therefore, subscribers and other persons interested in this periodical should communicate with the Director of the Botanic Gardens, Buitenzorg, Java, Dutch East Indies.

Botanists of the Second Millennium B.C.

AN interesting short paper by Prof. F. E. Weiss (*J. Roy. Hort. Soc.*, 66, Pt. 2, February 1941) directs attention to the "Court of Flowers" in the Festal Temple of Thutmosis III (1501–1447 B.C.) at Karnak. This ruler aspired to, and attained by conquest, a considerable empire in Syria and Palestine. He appears to have been unique in that he ordered botanical exploration to follow totalitarian imposition, and published his results as bas-reliefs upon the walls of the Court of Flowers at Karnak. Many species are unidentifiable, but others cannot be mistaken. These include the blue water lily, *Nymphœa cœrulea*, the pomegranate, vine, two species of arum (*A. italicum* and *A. Dracunculus*), a species of Kalanchoë and one of Iris. The fruits of sycamore (*Ficus sycomorus*) and a capitulum of *Chrysanthemum coronarium* are less certain, though probable, namings. It is rather curious that some of the species are now regarded as native in Egypt, but this lithological publication of botanical geography distinctly speaks in hieroglyphic inscription of "all the beautiful flowers which the power of His Majesty has collected when His Majesty was making war on upper Palestine so as to conquer the countries".

Food from the Poppy

Temperate regions have relatively few oil-yielding plants, and under the stress of war-time needs, Dr. R. Melville makes the interesting suggestion (*Gard. Chron.*, Feb. 8) that the oil (opium) poppy, *Papaver somniferum*, would be a suitable crop to grow in Great Britain as a source of fatty nourishment. The seeds have a pleasant, nutty flavour, and contain about 50 per cent of edible oil, with 20 per cent of protein. It is thought that yields of 8 cwt. of seed per acre should be possible in the climate of Great Britain. The seeds do not contain any toxic or narcotic substances, and the most potent vindication of the suggestion is that about twenty acres of the crop used to be cultivated regularly in the Isle of Axholme.

Czechoslovakia: Twenty Years of Independence

UNDER the above title, Prof. R. J. Kerner of the University of California, Berkeley, U.S.A., has edited a comprehensive and frank appraisal of the cultural, scientific, educational and social progress achieved by the Czechoslovak nation during the two decades it was in charge of its own destinies (University of California Press. Pp. xxii + 504. 5 dollars. 1940). As this work of more than five hundred pages shows, the record is a remarkable one and its very greatness makes all the more poignant the circumstances whereby the nation lost its independence. In producing this important work Prof. Kerner had the co-operation of twenty distinguished British, American and Czechoslovak scholars possessing first-hand knowledge of their subject. Thus, Prof. Aleš Hrdlička, of the Smithsonian Institution, writes authoritatively on Czechoslovak anthropology. Other writers trace the nation's history, its humanitarian progress, educational policy, music, arts, science and literature.

There are sections on the Little Entente, Czech democracy, social and religious legislation, and a valuable chronology tracing the fundamental happenings which concern the Czechoslovak peoples from 500 B.C., when Gaulic-Celtic tribes inhabited the land, "until July 21, 1940, when the new republic was recognized by Great Britain". Czechoslovakia is not a dead issue, for within the limits of that State and integrated in that people are the fundamentals of all that democratic Governments believe in and all that individual right holds as its standard.

The Resources of India

A RECORD and a review, 1939–1940, "India at War" by Sir George Dunbar, with a foreword by Field-Marshal Lord Birdwood, which has just been issued by the Ministry of Information, acquires further interest from recent developments and in the Near and Far East. Sir George Dunbar reviews briefly the help which India has given and is giving in the war against Nazism, including the expansion of her fighting forces, the loyal response of the Indian States and India's economic effort. Great increases are being made in the fighting services, but the most valuable and immediate help India can give is industrial. Sir George reviews India's potential economic reserves in relation to strategy and the conservation of shipping, stressing the importance of her contribution in oils and fats, jute, rubber, hides and skins, etc., as well as the striking development of the iron and steel industry. India is computed to be turning out 90 per cent of her own requirements as well as meeting overseas orders for ammunition, explosives, military equipment and clothing, while the manufacture of aluminium is beginning and aircraft construction is under consideration.

The Grand Coulee Dam

ON March 22 the official opening took place of the great hydro-electric and irrigation scheme on the Columbia River, Washington, across which the Grand Coulee Dam has been erected. The River Columbia rises in the Rocky Mountains in British Columbia, and after crossing the Canadian boundary flows through the State of Washington to the Pacific Ocean. Its lower courses form the boundary between Washington and Oregon. The scheme has been designed for the generation of electric current and for irrigation purposes. The concrete dam, which impounds water in the 150-mile stretch up to the Canadian boundary, is 4,200 ft. long with a maximum height of 553 ft. Its mass is greater than the Boulder Dam, and its construction—details of which are now being published in the *Engineer*—has taken about eight years.

When completed there will be two power houses with twenty-one generators with a total capacity of about 1,974,000 kw., but the first load was of only about 10,000 kw. At the west side of the dam will be a pumping house with twelve large electrically driven pumps raising water from the reservoir into a vast balancing basin from which the water will be distributed by a series of canals, over an area of

1,200,000 acres of land, now dry and barren, thus providing farm land for some 75,000 people. The irrigated area, it is expected, will ultimately be the home of more than a million.

Tuberculosis in the Navy

AT a meeting of the Section of Epidemiology and State Medicine of the Royal Society of Medicine on March 28, Surgeon-Rear-Admiral S. F. Dudley and Surgeon-Commander W. G. C. FitzPatrick read a paper on epidemiology in the Royal Navy, especially as regards the use of miniature radiography. They stated that tuberculosis is an occasional disease of sailors. Although its ravages were much greater in the last century, there has been no decline in its prevalence in the present century, in spite of energetic measures to prevent it. This is due to the unpreventable degree of overcrowding which must exist in warships and the presence of numerous unsuspected cases of open pulmonary tuberculosis. Measures designed to weed out these sources of infection have hitherto failed; little effect on total incidence can be expected from the X-ray examination of recruits or limited numbers of contacts. Periodic X-ray examination of the total force by the usual technique is considered impracticable, therefore the more rapid and economic technique of mass miniature radiography has been instituted. Some preliminary results on the first twenty thousand examinations were given and the organization of the first Naval Miniature Radiographic Department was described.

Jewish Population of Palestine

THE Statistics Department of the Jewish Agency Executive records that the Jewish population of Palestine has increased by immigration and natural increase from 174,606 in November 1931, according to the official census of that time, to 488,600 in September 1940. This estimate is 30,000 higher than that of the Government, which puts the Jewish population at 456,743 in June 1940. The Jews now represent 31·2 per cent of the settled population of Palestine. In 1931 the percentage was 16·9, and in 1922, when 83,790 Jews were enumerated after the British occupation, it was 11·1.

Health of Iceland

ACCORDING to the latest annual report of Dr Vilmundur Jonsson, director of public health, health conditions in Iceland are generally satisfactory. The death-rate is 10·2 per 1,000, and the infantile mortality-rate of 29 per 1,000 is remarkably low; deficiency diseases are infrequent, rheumatic fever and diabetes are rare, and diphtheria, which was once very fatal among children, is now kept in check by immunization. On the other hand, there is a relatively high rate for tuberculosis, and pneumonia is an important cause of death.

Steel Armouring of Cables

MR. R. W. L. PHILLIPS, borough electrical engineer of Bedford, has an article in the *Electrical Review* of January 10 on the present prohibition of steel armouring on electric cables. In the early days of electricity supply, the practice of laying cables direct in the ground without conduits or some similar protection was looked upon by many as being risky, principally because in many soils the lead sheathing would be liable to attack by corrosive salts. As a matter of fact, this did occur until a suitable compound was found for impregnating the protective jute covering. Armouring was added as a safeguard against mechanical damage. The usual method that is adopted to protect a cable that is to be laid direct in the ground, is to 'serve' the lead sheathing with a layer of jute before laying on the armouring, and a further layer of impregnated jute to protect the armouring from the corrosive action of the soil. The first layer acts as a bed for the armouring, thus preventing it damaging the lead; but, in Mr. Phillips's opinion, the success of direct-laid underground cable is due not so much to the armouring as to the double layer of impregnated jute so made necessary.

It remains to be considered whether the armouring of the cable, as normally provided, is a sufficient mechanical protection to justify its expense and the use of so much steel which is urgently required for other purposes at the present time. Mr. Phillips's experience in Bedford is helpful here. In this borough some 230 miles of medium voltage cable, 80 miles of cable up to 3,000 volts and about 45 miles of higher voltage cables, all without armouring, were laid in the ground. In the manufacture of unarmoured cables for direct laying, it is in some cases the practice to provide the cable with two layers of impregnated paper directly over the lead, as a protection against chemical action. This is followed by a final covering of two layers of doubly impregnated jute. If it could be done without unduly putting up the cost of manufacture, a better method would be to 'braid' the final jute covering under a stream of compound when manufacturing the cable. There are two incidental advantages in the use of an unarmoured cable. It weighs less, which affects both transport and handling; it is easier to joint (this is especially useful when making service connexions to low-voltage distributors). Mr. Phillips quotes data in connexion with an extensive and intensive electrification of a rural area of about 200 square miles. In the majority of the villages in this area it actually cost less to lay unarmoured low-voltage distributors than to provide the same service by means of overhead wires. Some of the cables in the Bedford area have been in the ground many years and no trouble attributable to the absence of armouring has been experienced.

Mummification in America

DR. ALEŠ HRDLIČKA, of the Smithsonian Institution, Washington, prefaces extracts from his diaries of 1936–38, when he was exploring for mummies on the Aleutian Islands, now appearing in the *Scientific Monthly* (January 1941), with some general considerations on the practice of mummification. As is well known, this practice has rather a remarkable distribution. In the ancient world it apparently remained limited to Egypt, though extending to some extent to the Canary Islands. In later times it was practised in the Torres Straits, and developed in two widely separate regions in the Americas—in Peru and the neighbouring territories and among the Gulf populations of Alaska, more particularly in the Aleutian Islands. Mummification, however, may be of two kinds: the natural, due to lack of moisture in climatic conditions; and the artificial, in which initially the internal organs are removed.

It will be remembered that the late Sir Grafton Elliot Smith was first stimulated to formulate his theories of the origin and diffusion of culture in and from Egypt by the identities in method in preparing the body for mummification in ancient Egypt and the Torres Straits—identities which he maintained were of such a highly technical character as virtually to preclude an independent origin. Dr. Hrdlička, without more direct reference to the controversial issue, points out that it is not known how the practice started in America. Origin in and transmission from Peru to Alaska seems far-fetched, but so too does the reverse process. It is difficult, however, to connect either region with Egypt. Yet such a connexion is not impossible; but until Siberia is more fully explored, the problem must be regarded as at present incapable of solution. In the meantime, it is noted that while the Egyptians embalmed the body and then bandaged it, the Americans used air-drying, stuffed it with moss or grass and dressed it in its best clothes.

Recent Earthquakes Recorded at Kew

Ten relatively large earthquakes have been recorded at Kew Observatory during the period February 2–March 16. The one which gave rise to the greatest amplitudes was that received on March 1, compressional at 3h. 57m. 22s. G.M.T., the epicentre being near Larissa in Greece (Nature, March 8, p. 292). The S wave arrived at 4h. 1m. 4s. G.M.T., L_Q at 4h. 2·5m., and L_R at 4h. 3m. There were three maxima, the first being the greatest, and having an amplitude of 150μ. The estimated epicentral distance from Kew was 2220 km., all calculations and readings being provisional. Three earthquakes were recorded on March 16. The first, at 7h. 54m. 17s. was probably from an epicentre 8480 km. distant, whilst the second at 16h. 38m. 52s. was most likely from an epicentre 1770 km. distant and may have been the shock reported to have been felt at Trapani and Palermo in Sicily. It gave rise to amplitudes of 35μ at Kew. The third shock, at 18h. 52m. 9s. beginning with a dilatational pulse, may have been an aftershock of the Palermo shock, though at Kew exact reading of the seismogram was difficult owing to confusion caused by microseisms.

Earthquake near New Guinea

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has made a preliminary determination of the epicentre of the earthquake of January 13, 1941. From reports received from the seismographic stations at Honolulu, St. Louis, Manila, Pasadena, Sitka, Logan, Chicago, Fordham, Philadelphia, Lincoln and College (Alaska), the epicentre appeared to be at latitude 3° S., longitude 144° E., which is in the Pacific Ocean north-west of Cape Girgir in New Guinea and almost due west of the Purdy Islands of the Admiralty Islands group. The depth of focus is estimated to have been near 100 km., which is not unexpected since the epicentre lies in a belt well known for the prevalence of deep focus earthquakes in the past. The initial time of the shock was probably 16h. 27·7m. G.M.T.

Periodicities in Solar Variation

Referring to the account of his paper on "Periodicities in Solar Variation reflected in Weather" published in Nature of October 26, 1940, p. 564, Dr. C. G. Abbot writes that, in the tabular matter in column 1, 24·9 months should read 25⅕ months, which later studies indicate to be preferable. It is also stated that the exact periods are given as the result of scattered *solar* observations made prior to 1920. This is incorrect. These values come from evidences of the solar periods in the *temperature* and *rainfall* records of Copenhagen, Vienna, and New Haven, 1800–1932. Further evidence will be given in a paper soon to be published in *Smithsonian Miscellaneous Collections.*

Announcements

The American Philosophical Society has made a gift of 10,000 dollars to the Royal Society "for the aid of science in Britain". This generous gift, from the oldest scientific society in the United States, is a welcome gesture marking the spirit of friendship between the men of science of the two countries, and emphasizing the determination of American scientific workers to aid their colleagues in Great Britain to carry on the pursuit of knowledge.

A discussion on "Vegetables as Food" has been arranged by the Nutrition Panel of the Food Group of the Society of Chemical Industry, to take place at the British Medical Association House, Tavistock Square, London, W.C.1, on April 9. The papers to be presented will deal with the chemical composition of vegetable foods, the planning of vegetable production, and the effects on nutritive value of cooking, canning, drying and other forms of preservation.

The Royal Society for the Prevention of Accidents states in the current number of *Safety Training* that there has been for some time a continued alarming increase in road accidents in children, despite all efforts of teachers, education authorities and parents. The increase has been attributed to absence from schools and the slackening of discipline in the early war months, and also to change of environment from city to rural life.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "letters" will not be submitted to correspondents outside Great Britain.

Science and Government

The general control of scientific research by the State, which is envisaged in the article on "Science, Politics, and the Government" in the issue of Nature of March 8, is fraught with a more serious danger than any there discussed. There is little fear, if I know my countrymen, that our men of science will allow their research work to be biased by political, racial or religious considerations; or, indeed, that any pressure will be put upon them to do so when the excitements and passions of the present abnormal times have died down. The real danger is the one which Dr. O. Blüh points out so forcibly in his communication in the same issue of Nature: the danger to freedom of all kinds which is inherent in the very conception of the 'planned' state.

The applications of science to everyday life have become so important that it is, no doubt, natural and perhaps even desirable that society which reaps the benefits—and suffers the consequences—of this particular type of scientific activity should supervise and subsidize its further progress. Applied science is, however, only one aspect of research activity. The claim is now being made, in certain scientific circles, that utility on the material plane is the *only* justifiable motive for any research, and that all research should be directed and, if necessary compelled, to utilitarian ends. The assiduity and vigour with which this claim is pressed by its supporters is probably (as they would express it) "conditioned by their ideology", for few of them seem to be much influenced by the principle in their own research work. It is this claim against which Prof. Polyani was protesting in his communication to Nature. It is, however, a claim which is only too likely to appeal to a 'directing' government committee, however eminent its composition. Herein lies its danger.

"The fundamental point on which all can agree," as the article points out, "is that science represents the search for truth." The true motive for such a search is (to adapt the dictum of Plato) not utility but wonder. In spite of the difference in their working media, the man of science, philosopher, poet and artist belong to the same category; as anyone who has had the privilege of working under any of the great men of science of the age can easily realize. It is a class which cannot be 'organized' by any committee, and which does not respond to 'control' however well-intentioned. Yet the progress of science depends on such men's passionate pursuit of the truth. "The wind bloweth where it listeth", and to attempt to harness pure research to the chariot of utility would, if successful, only result in the gradual cessation of all progress. Modern materialism, masquerading under the name of 'scientific' planning, may well prove to be the most serious enemy which science has yet had to face.

J. A. Crowther.

The University,
Reading.

In Nature of March 8, Dr. E. C. Childs writes: "If we are deprived of experiment we must fall back on experience, that is, appeal to authority, which is admittedly less satisfying than scientific demonstration; and we cannot, as men of science lacking our chief weapon, expect to prevail in conflict with authority". Is not this a rather forced differentiation between "experiment" and "experience"? Experience is the outcome of the observation of facts. It surely does not matter whether those facts are obtained from a series of casual incidents or from pre-arranged reactions. There is no branch of science which does not owe a great deal to observation of casual—and frequently serendipitous—events. Admittedly it is convenient and convincing to be able to repeat as and when required an experiment to reinforce a specific argument, but that does not imply that experience is "less satisfying than scientific demonstration". As for "authority", "experiment" relies upon it quite as much as "experience", for the bulk of men have to accept the findings of the few specialists. In other words, they have to rely upon the authority which they accord to the expert.

When, then, Dr. Childs suggests that scientific men "should arm themselves with authority", he means no doubt that they should co-operate to insist on the observation of facts which they have gleaned by experiment and experience. They do that already through the Royal Society and a score of other influential bodies in subjects falling within their acknowledged spheres of influence; the suggestion is now that they should do it also in spheres —political and sociological—that are not usually recognized as within their ambit.

The question under debate is whether or not their training in precise observation and logical thinking fits them to do so better than other men who lack those qualifications. Surely a distinction must here be made between science and the scientific workers. It is devoutly to be wished that all men would consider political and, particularly, social problems, with the detachment from personal bias which ought to characterize scientific work. But the man of science is a human being like the rest of us, never simply and solely an observing and calculating machine, and he is swayed by the same emotions and subject to the same bias as his fellow men. There are many cases in which well-known men of science have shown themselves unable to bring logical thought to bear on non-scientific subjects.

Generally speaking, however, the scientific man is wholly honest, but unfortunately he is often a babe outside his own, sometimes a very narrow, field.

It seems then highly probable that your genuine man of science will only very rarely make a good legislator or a good administrator. But on the other hand, if he can inculcate the spirit of science, the scientific method, into sociological affairs, and if he can within his own sphere provide men of commoner clay with the facts from which proper deductions may be drawn, and if moreover he can present those facts with the authority to which Dr. Childs refers, is it not conceivable that he may be of greater service to his generation than if he takes a seat in Parliament or in political organizations ?

LOUGHNAN PENDRED.

The Athenæum.

THE admirable statement of the case in NATURE of March 8, p. 275, makes further comment unnecessary, but as I am referred to and as my letter in NATURE of January 25, p. 119, has been misinterpreted by some correspondents, perhaps I may be permitted to say that in advocating control by science after the War as a means of making good the destruction of wealth due to it, I did not intend to convey that men of science were to be in a position to dictate to the elected representatives of the people.

I am wondering if the following suggestion would be practicable: that a select committee or commission should be appointed to consider and report upon the best scientific methods of making good the ravages of war. An advisory council representative of all sciences might be set up, to whom all standing in need of scientific advice would have access, whether Government officials, farmers, industrialists, or whatever they may be. Sacred though freedom is, people ought not to be free to waste the national wealth in the present crisis by exploitation or unscientific activities.

ROBERT H. F. FINLAY.

Victoria Square,
Belfast.

Can Science be Independent?

PROF. A. V. HILL[1], in discussing State aid for science, directs attention to "the danger that he who pays the piper may call the tune, that research may be devoted primarily to objects which the politician, or the Civil servant, regard for the moment as of national importance", and demands that "the independence and integrity of science must be carefully safeguarded". A casual reader might suppose that in Great Britain before the War, men of science could choose their own field of research.

This is not the case. I am Weldon professor of biometry (defined as the application of higher mathematics to biological problems) not because I chose this topic, but because the late Mrs. Weldon left a large sum of money to endow a chair of this subject. I believe that I carry out my duties conscientiously, and I am doubtless lucky to find so congenial a post. But I should greatly prefer a chair of genetics which gave me more scope for experimental work. However, there is no such chair in England because no rich person has endowed one. In fact the fields of scientific research in Great Britain are to a considerable extent determined by the wishes of rich men and women. This is not independence. It is true that professors who are paid to devote themselves to one subject often carry out excellent research in another. Professors of human anatomy have given conspicuous examples. But it may be doubted whether this can always be done without a certain sacrifice of integrity, such as is made by clergy who interpret the creeds or the thirty-nine articles in a 'broad' manner which enables them to enjoy ecclesiastical emoluments whilst deviating from the purpose for which they were provided.

The plain fact is that science cannot be independent because it does not exist in a vacuum, and that complete intellectual integrity is very difficult except for those who are so fortunate that their opinions coincide at all points with those of their rulers.

Until such facts are realized, men of science will be likely to cherish the delusion that they can hope for complete liberty in a society where others do not share it. We can no more escape from a large measure of control by our social surroundings than from the earth's gravitational field. For this reason I believe that every man or woman of science should make some kind of study of social and economic relations in order to understand the conditions under which he or she must work.

I should like to go beyond Prof. Hill in one direction regarding his suggestions for co-operation with the fighting services. During the present War I have worked for all three. Some of the topics were very properly secret. Others, relating to hygiene in the broadest sense, were certainly not. Had certain of the problems under investigation been solved before the outbreak of war, a number of lives would have been saved. They would have been solved had biologists outside the services known of their existence. The barrier of secrecy around such questions has not merely protected the services from spying, but also from progress. In matters which concern the health and safety of personnel, there should be far more freedom of discussion than existed before the present War, and *a fortiori* vastly more than exists to-day.

J. B. S. HALDANE.

University College,
London, W.C.1.

[1] NATURE, 147, 251 (1941).

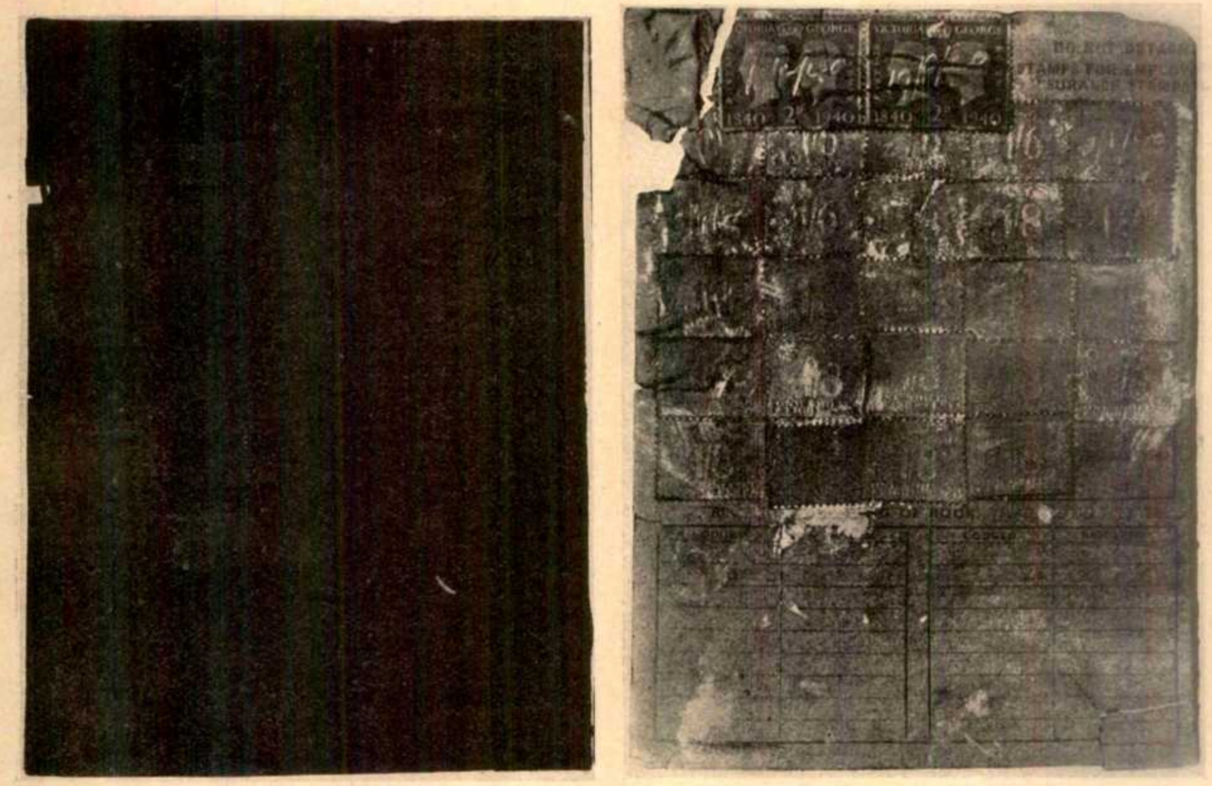
Prof. Haldane's denial that "before the War men of science could choose their own field of research" seems to be based on his own academic position—which is surely an exceptional one. By far the majority of university chairs are not endowed by private individuals, and most of them that are have no ultra-specific conditions attached to them. Prof. Haldane's statement that "the fields of scientific research in Great Britain are to a considerable extent determined by the wishes of rich men and women" savours of naïvety. Further, he states that there is no chair of genetics in England; this seems to overlook the Arthur Balfour chair of genetics at Cambridge, recently vacated by Prof. R. C. Punnett, and temporarily in suspense.

EDITORS OF NATURE.

A New Method for the Decipherment of Charred Documents

IN view of the widespread destruction by fire of documents of all kinds which is taking place at the present time, we think it desirable to put on record the preliminary results of some experiments in progress at this laboratory on the decipherment of charred documents. In spite of its topical interest, the subject is not a new one[1]; but we have already obtained results which we think, taking into consideration the simplicity and general applicability of the method, mark a distinct advance on anything hitherto recorded.

Briefly, the method consists in treating the document with chloral hydrate; this substance appears to exert an as yet unexplained 'clarifying' action on the burnt figures or letters. The chloral hydrate is applied in a 25 per cent alcoholic solution; after several applications, the document being dried at 60° C. between each, a mass of chloral hydrate crystals will form on the surface, and at this stage a similar solution containing 10 per cent glycerine is applied and the document dried as before. It may then be photographed. The most suitable type of plate is a contrasty non-colour sensitive one (for example, Ilford 'Thin Film Half-Tone').



PAGE OF AN UNEMPLOYMENT INSURANCE BOOK CHARRED DURING THE LONDON FIRE ON DECEMBER 29; BEFORE TREATMENT (LEFT) AND AFTER TREATMENT (RIGHT).

The accompanying illustration shows the type of results obtained. The method is equally satisfactory for typescript and for printing, and with certain modifications has been found to restore writing. Furthermore, the reading matter is restored equally on both sides of the paper.

Certain distinct advantages which are possessed by this method are: (1) it appears to be applicable to any type of document; (2) it is fairly quick; (3) it has never yet in our hands failed to produce a readable result; (4) it requires no special apparatus other than a copying camera.

It has so far eluded us to find a satisfactory explanation in physical or chemical terms of this action by chloral hydrate; but it is hoped that this problem will also be solved. Such a solution ought to put the method on a rational basis, and open the way for further advances. The allied problem of rendering the burnt document less brittle and more easy to handle during treatment is also being attacked.

We hope to publish a more complete account of these experiments in due course.

Our thanks are due to Dr. James Davidson, director of this laboratory, for permission to publish these results.

W. D. TAYLOR.
HENRY J. WALLS.

Metropolitan Police Laboratory,
Hendon, The Hyde, N.W.9.
March 13.

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[1] See, for example, Lucas, "Forensic Chemistry and Scientific Criminal Investigation", 3rd. edn., 142 (1935); Ainsworth Mitchell, "Inks", 3rd. edn., 173 (1924); Tyrrell, *J. Criminal Law and Criminology*, 30, 236 (1939). (The first two sources give a number of references to earlier publications on the subject.)

Bacteriostatic Action of Nitrates

ALTHOUGH nitrites have been used officially in meat curing processes for well over a decade in the United States[1], it is only comparatively recently that their use has been permitted in Great Britain[2]. Undoubtedly, the predominant reason for their inclusion in cured meats has been the fact that they occasion a desirable colour in the finished product[3]; but it appears that they may also play an important part in producing a typical "cured" flavour[2]. When consumed directly, quantities of sodium nitrite in excess of 0·2 gm. may produce marked toxic effects in man[4] so that their use in foods must be strictly controlled. For this reason pure food regulations both on the North American continent and in Great Britain forbid the inclusion of more than 0·02 per cent (200 parts per million) of sodium nitrite in cured meats.

Very little attention appears to have been paid to the fact that nitrites may, under certain conditions, play an important part in retarding bacterial development on, and thus delay the spoilage of, meats and related products. Lewis and Moran[5] observed that growth of the mixed bacterial flora of minced beef in experimental brines was retarded by 0·03–1·5 per cent of sodium nitrite. Their work, as well as that of Tanner and Evans[6], indicates that the growth of strict anærobic bacteria of the genus Clostridium is inhibited only by relatively large amounts of nitrite. Other investigators[7,8] have observed that 0·4 per cent of sodium nitrite inhibits the growth of certain facultative anærobes. Thus most of the available literature has indicated that it is only rather large concentrations of nitrite, usually greatly in excess of the 0·02 per cent permitted by law, which will hinder or prevent bacterial development.

About two years ago experiments were carried out at this Station in which it was shown that bacterial spoilage of fish flesh is strongly delayed by incorporation of small amounts of nitrite salts[9]. The reason for this was sought, and it was found that bacteria are only susceptible to low concentrations of nitrites at *p*H values below 7·0, and that the muscle of fish shortly after capture becomes sufficiently acid (for example, *p*H 6 to 6·6) for these salts to exert their bacteriostatic action[10]. Not all bacteria studied have proved equally susceptible to nitrite, and certain organisms do not appear to be inhibited. However, growth of species of the following bacterial genera at *p*H 5·7 or 6·0 has either been markedly inhibited, or in certain instances entirely prevented, by 0·02 per cent of sodium nitrite: Achromobacter, Flavobacterium, Pseudomonas, Micrococcus, Escherichia and Aerobacter (also one species of Torula)[11].

Attempts have been made to determine by what mechanism nitrites exert their inhibitory action. The possibility that they act by combining with respiratory hæmatin compounds suggested itself, especially in view of the fact that Ingram[12] has found that oxygen uptake in the case of the aerobic, cytochrome-containing organism, *Bacillus cereus*, is very strongly inhibited by traces of nitrite. However, it has been found that there is no apparent relationship between inhibition of growth by nitrite and its effect on respiration. Thus in certain instances growth of a given organism was strongly or completely inhibited at *p*H 6·0 by 0·02 per cent sodium nitrite, whereas under similar conditions its aerobic respiration was not significantly inhibited[11]. The possibility that salts of this type inactivate certain enzymes by combining with their amino groups as was originally suggested by Quastel and Wooldridge[13] must not be overlooked. Since it has recently been shown that certain organisms remain viable after exposure to 38·8 per cent sodium nitrite at *p*H 3–8 for ten minutes[14], it would appear rather unlikely that nitrites are able to act in a bactericidal capacity.

H. L. A. TARR.

Pacific Fisheries Experimental Station,
Prince Rupert, B. C. Feb. 10.

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[1] Kerr, Marsh, Schroeder and Boyer, *J. Agric. Res.*, **33**, 541 (1926).

[2] Brooks, Haines, Moran and Pace, Food Inv. Bd. Gt. Brit., Spec. Rep. No. 49 (1940).

[3] Brooks, *Proc. Roy. Soc.*, B, **123**, 368 (1937).

[4] Reiss, Meyer and Müller, *Z. Untersuch. Lebensmittel*, **55**, 325 (1928).

[5] Lewis and Moran, Inst. Amer. Meat Packers, Bull. No. 4 (1928).

[6] Tanner and Evans, *Zbl. Bakt.*, Abt. II, **91**, 1 (1934).

[7] Stephenson, "Bacterial Metabolism", London (1939).

[8] Landerkin, *Food Res.*, **5**, 205 (1940).

[9] Tarr and Sunderland, Fish. Res. Bd. Can., Prog. Rep. Pacific, **39**, 13 (1939); **40**, 14 (1939); J. Fish. Res. Bd. Canada, **5**, 148 (1940).

[10] Tarr and Sunderland, Fish. Res. Bd. Can., Prog. Rep. Pacific, **44**, 16 (1940).

[11] Tarr, *J. Fish. Res. Bd.* Canada (in press).

[12] Ingram, *J. Bact.*, **38**, 613 (1939).

[13] Quastel and Woolridge, *Biochem. J.*, **21**, 148 (1927).

[14] Bittenbender, Degering, Tetrault, Feasley and Gwynn, *Ind. Eng. Chem.*, **32**, 996 (1940).

β-Glucosaminase in Testes

DIFFUSING factor preparations from various sources cause a rapid decrease in the viscosity of certain mucins (for example, hyaluronic acid) and if contact is maintained for a longer period hydrolysis of the polysaccharide can be detected by an increase in the reducing power of the mixture[1]. Since the mucins in question are believed to be built up of N-acetylglucosamine and uronic acid residues it seemed likely that an enzyme capable of hydrolysing them would also hydrolyse other N-acetylglucosaminides. It has, in fact, been demonstrated (see accompanying table) that a concentrate of testicular diffusing factor[2] will hydrolyse N-acetyl-β-phenylglucosaminide much more readily than any other glycoside examined.

	Time of incubation at 37° C. (hr.)			
	1	2	6·5	24
	% hydrolysis (Bertrand)			
N-acetyl β-phenyl glucosaminide	4·6	9·3	18·7	28·4
β-phenyl glucoside	1·3	1·3	1·8	3·3
Salicin	0	0	1·5	1·8
Sucrose	1·7	1·7	3·3	2·7
β-menthyl glycuronide	0	0	0	0

The optimum *p*H for this β-glucosaminase (4·8) is close to that at which diffusing factor preparations exert their maximum effect on the viscosity of hyaluronic acid[3]. There are, however, certain facts which suggest that the two effects—decrease in viscosity and increase in reducing power—may not necessarily be due to the same enzyme. When mucins of the hyaluronic acid type are treated with $M/5$ HCl or $M/5$ NaOH at 25° C. a gradual and irreversible decrease in viscosity occurs. Glycosidic linkages are, as a rule, stable to alkali under these conditions, and it may well be that the viscous material contains linkages of some other type. Moreover, crude emulsin preparations which show β-glucosaminase activity do not affect the viscosity of hyaluronic acid.

A more detailed account of the β-glucosaminase activity of testicular extracts and its bearing on the problem of diffusing factors will be published elsewhere.

MARJORIE E. EAST.
J. MADINAVEITIA.
A. R. TODD.

Chemistry Department,
University of Manchester.
March 20.

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[1] Chain and Duthie, NATURE, **144**, 977 (1939).

[2] Madinaveitia, *Biochem. J.*, **32**, 1806 (1938); **33**, 347 (1939).

[3] Madinaveitia and Quibell, *Biochem. J.* **34**, 625 (1940).

RESEARCH ITEMS

Stone Implements from Ceylon

A collection of stone implements made by N. A. and H. V. V. Noone during a three months visit to Bandarawela numbers some two thousand specimens which have been classified systematically (*Ceylon J. Sci.*, Sect. G, **3**, 1 ; 1940). Several new types are included ; tentatively sixty types and varieties are differentiated. The richest sites are those reported by the Sarasins (1907) and Hartley (1913), but most hill crests not too far above the valley bed show vestiges of prehistoric man on or just below the surface. These finds were made mostly on the surfaces of the knolls and rises along the ridges of the grassy *patnas*, especially on the eastern brows, the larger pieces mostly on the slopes. Several specimens were extracted from a depth of 24 inches, but this is no criterion of age. Knapping tools and core-like pieces indicate working sites. With rare exceptions the material is quartz and rock crystal. Only at two sites was there a source of raw material available nearby. There are many indications of the use of derivative pebbles or blocks taken from neighbouring stream beds. Workmanship and technique are varied, rough and fine, heavy and minute specimens lying together. The longest implements are a cleaver (16·5 cm. × 11 cm.) and an anvil (13 cm. × 12 cm. × 4 cm.) ; the smallest a little less than 1 cm. The carefully worked symmetry of the dew-drop crystal is so skilled as to suggest adornment rather than utility. The main headings of classification are : *A*, polyhedrals ; *B*, bifaces ; *C*, flake and blade ; *D*, geometrical ; and *E*, special. There was no evidence of bone or shell industry. A few sherds of pottery, thick and thin, of coarse paste with a pattern-like cross-plaited grass matting, were found. Red hæmatite points to the use of ruddle ; one piece approached more nearly a polished implement than anything previously recorded from Ceylon. As a whole the implements cannot fittingly be described as neolithic. Their forms are rather palæolithic or mesolithic. Nor can they be correlated with European divisions and cultures. They warrant the claim that in Ceylon has been found one of the most highly developed prehistoric quartz and crystal industries as yet discovered and deserving of its own distinctive label—that of Bandarawelian being here suggested. So far as observed it shows no evidence of a local origin or of cultural division, nor has evidence of an earlier culture been seen.

Substances producing Cancer of the Liver in Mice

Japanese workers discovered that azotoluene and the azo dye, butter yellow, induce malignant changes in the livers of rats and mice. It is now shown (Cook, Hewett, Kennaway and Kennaway, *Amer. J. Cancer*, **60**, 62 ; 1940) that 1 : 1′-azonaphthalene, 2 : 2′-azonaphthalene and 2 : 2′diamino-1 : 1′dinaphthyl resemble 3 : 4 : 5 : 6-dibenzcarbazole in that they are able to induce malignant changes in the livers of treated mice although they do not produce such changes in rats. Cholangiomata were also found in mice which were treated with 1-methyl-3 : 4-benzphenanthrene, 2-methyl-benzphenanthrene, 2-*iso*propyl-3 : benzphenanthrene and 1 : 2 : 3 : 4-dibenzphenanthrene. On the other hand, 1 : 2′-azonaphthalene, a large number of carcinogenic compounds and a few azo dyes used for food colouring did not induce any new growth in the livers of mice. There is thus marked chemical specificity in the induction of liver tumours, although the change occurs with some hydrocarbons and some nitrogenous compounds.

Red Sea Xeniidæ

The Xeniidæ form a small but interesting family of the Alcyonacea, the order to which the common dead men's fingers belongs. The members of it found in the Red Sea have been described by H. A. F. Gohar (Publ. Marine Stat., Ghardaqa, Red Sea). This work is not simply descriptive, however, and its scope is best indicated by its sub-title "Their Ecology, Physiology, Taxonomy and Phylogeny". Indeed the bulk of the paper is concerned with observations upon the living animals, and the position of the laboratory has enabled these to be made under natural conditions. This is an aspect of our knowledge of the group that needed amplification. Three new species are described, although it is suggested that a study of the life-histories of the living animals will reveal that a number of the names in the group are synonyms. The author has also studied the preserved material in Cambridge, Edinburgh and London for the purpose of comparison. Besides the generally accepted genera Xenia and Cespitularia, the writer also puts forward reasons for including Heteroxenia, Sympodium and Anthelia in the family, of which he gives an emended and more complete diagnosis. Sympodium he considers deserving of inclusion in a sub-family Neoxeninæ, separate from the others, which he terms the Euxeninæ. They were derived from the main stock near the primitive Anthelia.

The Smut Fungi

Two papers have recently appeared in the *Transactions of the British Mycological Society* which increase our knowledge of the smut fungus flora of Britain and of India. Miss Kathleen Sampson has collected records of the seventy British species of the Ustilaginales, with full reference to published literature (*Trans.* **24**, Pts. 3 and 4, 294–311 ; Dec. 1940). The work was completed in accordance with recommendations from the Society's Plant Pathology Committee, and is a potent link between general field mycology and the kind of record-knowledge demanded by the student of plant diseases. The second paper is by Dr. B. B. Mundkur (*Trans.* **24**, Pts. 3 and 4, 312–36 ; Dec. 1940), and brings a crop of new species of smut fungi recorded from India. *Ustilago Polytocæ-barbatæ* was discovered in the Sipna Valley as long ago as 1908, but is now recognized as a different species from other smuts upon the same host. *Tilletia Panici* was found on Panicum grass at Calcutta, and is different from the four species previously recorded on this host genus. *T. Taiana* is new, and also *Ustilago Neyraudiæ*, *U. Lachrymæ-Jobi* and *U. Euphorbiæ*. *Doassansiopsis Martianoffiana* is not a new species, but is of interest for its somewhat unpromising habitat upon the floating leaves of Potamogeton. Full descriptions are given for each species, and several critical re-namings are suggested.

'Take-All' Fungus on Oats

'TAKE-ALL' disease of wheat, caused by the fungus *Ophiobolus graminis*, has not hitherto been regarded as a parasite of the oat. Growth of the latter crop was, in fact, regarded as one of the measures of control, for in practice, on 'take-all' infested land, the interposition of an oat crop had the same effect of starving out the fungus as had bare fallow. Elizabeth M. Turner has now discovered a variety of the fungus which can attack the oat crop (*Trans. Brit. Mycol. Soc.*, **24**, Pts. 3 and 4, 269–281 ; Dec. 1940). Isolates of the pathogen from oats grown in Wales were indistinguishable in cultural behaviour from *O. graminis* obtained normally from wheat, but inoculation experiments showed different powers of infection. Ascospores were also larger in the Cambrian material. It is proposed to regard the fungus on oats as a new variety, *Avenæ*, of *O. graminis*. Its appearance is disturbing, but it is possible that the very limited distribution will still allow the use of the oat crop as a practical means of control of the 'take-all' disease of wheat in most regions.

Photosynthesis

SOME experiments on the photosynthesis reaction in green plants have been made by S. Ruben, M. D. Kamen, W. Z. Hassid and L. H. Perry (*J. Amer. Chem. Soc.*, **62**, 3443, 3450, 3451 ; 1940), using the green alga *Chlorella pyrenoidosa* and carbon dioxide containing radioactive carbon formed by the bombardment of boron oxide by deuterons : ${}^{10}_{5}\mathrm{B} + {}^{2}_{1}\mathrm{D} = {}^{11}_{6}\mathrm{C} + {}^{1}_{0}n$, and present in air to the extent of 1 to 5 per cent. It was found that carbon dioxide uptake occurs also in the dark at a rate independent of the chlorophyll concentration but related to the capacity for carrying out photosynthesis, indicating that it is a primary step in the process. Special experiments eliminated reduction of ${}^{11}CO_2$ by exchange reactions. Light and dark CO_2 reductions show the same sensitivity as normal photosynthesis to the action of inhibitors such as HCN. The chemical identity of the radioactive compounds formed in the dark is unknown, but the presence of at least one hydroxyl and one carboxyl group in the active molecules was established. Most of the ${}^{11}CO_2$ taken up in the dark was found in the carboxyl groups ; in the light a smaller but appreciable fraction was in the carboxyl groups. No radioactive carbon was found in formaldehyde or other volatile substances, even after very short exposures. Sedimentation velocities of the radioactive molecules formed indicate that their molecular weight is about four times that of sucrose. In a tentative mechanism it is supposed that RCOOH formed in the dark from RH and CO_2 is reduced to RCH_2OH in the light : $RCOOH + H_2O = RCH_2OH + O_2$, and this takes on another CO_2 molecule, and so on until a long chain is built up. The COOH group so formed is not active, as it can be formed by exposure to inactive CO_2. It is suggested that the primary photosynthetic process is not the formation of a CO_2-chlorophyll complex but the conversion of CO_2 to CO-OH on a large molecule, the subsequent photochemical reductions not producing formaldehyde. The scheme is correlated with the energy requirements for the various reactions.

Evolution of the Atmosphere

IT is known on geochemical grounds that, in all probability, the primitive atmosphere contained no free oxygen. J. H. J. Poole has, in a recent paper (*Sci. Proc. Roy. Dublin Society*, **22**, No. 36 ; Feb. 1941), considered its probable constitution in the light of the data supplied by the average composition of the igneous and sedimentary rocks of the lithosphere and estimates of the total mass of igneous rocks denuded during geological time. From these it would seem that the free carbon now present in the sediments could not all have been derived from the carbon dioxide in the primitive atmosphere. This may have contained large quantities of methane, but there are grave objections to this view. The original liberation of free oxygen is attributed to the photodissociation of water vapour in the upper atmosphere, followed by the gradual escape of hydrogen, rendered possible by the high temperature probably occurring in this region. This might cause the accumulation of sufficient oxygen to allow plant life to start, and then produce by photosynthetic decomposition of carbon dioxide the main part of the oxygen which is present to-day, or has been used up in the formation of the sedimentary rocks. The author considers quantitatively the various problems involved in this theory, and shows that the original accumulation of free oxygen would have been a slow process. This view agrees with the fact that there is no evidence to show that life existed on the earth during, at least, the first half of the age of the ocean. After a brief discussion of the apparent absence of both oxygen and water vapour from the outer atmosphere of Venus, the author concludes by pointing out that in the present state of our knowledge the views advanced in the paper must be regarded as highly speculative.

Aluminium and Lithium Borohydrides

H. I. Schlesinger, R. T. Sanderson and A. B. Burg (*J. Amer. Chem. Soc.*, **62**, 3421 ; 1940) have examined the properties of the compound AlB_3H_{12}, obtained by the action of aluminium trimethyl on diborane : $Al_2(CH_3)_6 + 4\,B_2H_6 = 2B(CH_3)_3 + 2AlB_3H_{12}$. It forms colourless crystals, m.pt. −64·5°, b.pt. (extrapolated) 44·5°, is a non-polar compound, and in its chemical properties resembles diborane, reacting vigorously with oxygen, water and hydrogen chloride, and forming addition products with equimolecular amounts of dimethyl ether and trimethylamine, which compounds undergo complex reactions on heating. AlB_3H_{12} reacts with lithium ethyl to form $LiBH_4$ and evidence of the existence of BeB_2H_8 was obtained. The aluminium compound may be formulated as $Al(BH_4)_3$. Electron diffraction measurements with AlB_3H_{12} (J. Y. Beach and S. H. Bauer, *J. Amer. Chem. Soc.*, **62**, 3440 ; 1940) lead to a possible configuration and interatomic distances. The Al atom is linked to three BH_4 groups at angles of 120°, the molecule being planar except for the hydrogens. The boron atoms are located near the centre of trigonal bipyramids formed by the four H atoms of each BH_4 group and the central Al, and the interatomic distances are Al-B $2{\cdot}14 \pm 0{\cdot}02$ A., B-H $1{\cdot}27 \pm 0{\cdot}04$ A. The electronic configuration of the molecule is discussed on the basis of a number of structures in resonance. The preparation and properties of lithium borohydride $LiBH_4$ are also described (H. I. Schlesinger and H. C. Brown, *J. Amer. Chem. Soc.*, **62**, 3429 ; 1940). It differs from the aluminium and beryllium compounds in not furnishing borine trimethylammine, $H_3B : N(CH_3)_3$, with trimethylamine. LiB_4H_2 melts at 275° and decomposes at the same temperature. A salt-like structure $Li^+BH^-_4$ is suggested.

SHEEP TICK AND SHEEP MAGGOT PROBLEMS IN GREAT BRITAIN*

THE sheep tick, *Ixodes ricinus* L., in the British Isles is confined principally to the uncultivated regions, the hills and moorlands, the wooded districts or areas of peat bog. It is responsible for the transmission of louping ill and tick-borne fever in sheep and for widespread pyæmic infections in young lambs. The losses in sheep stock may be very severe if the flock has not been acclimatized to these diseases. Death-rates of upwards of 50 per cent have been recorded in the first year of exposure to infestation by disease-infected ticks.

The tick can live on a variety of hosts, and experiment has shown that it can survive as a species in the absence of sheep. The physical factors controlling its distribution have been shown to be moisture during the summer and possibly temperature during severe winters. The conditions of high humidity in the summer and protection from black frosts in the winter are only to be found in rough pastures over peaty or acid soils where there is a layer of moss and rank or old vegetation; that is, precisely those vast expanses of wild moorland and hill the reclamation of which is out of the question. The protection of the sheep by chemical means has therefore been the main line of attack.

Over the greater part of Britain the tick has two seasons of activity; it appears in large numbers on sheep in spring and early summer, and to a less extent in the autumn. Provided sheep can be protected during these periods, they may be allowed to graze over infested pastures without precautions during the rest of the year.

Sodium arsenite (0·2 per cent arsenious oxide) has been shown to continue to kill adult female ticks attaching to sheep for a period of 10–14 days. Derris, at a concentration of 0·02 per cent resin, has a similar effective duration. The addition of wool grease enhances the effective duration of arsenic but not of derris. Based on these findings, a protective dip has been evolved which gives protection of a high order during the first week or ten days, when the ticks are killed by the derris before they can attach. Afterwards the protective effect is due to the arsenic, which kills the females after they attach. For this dip an immersion period of at least half a minute is necessary. The dip is suitable for dipping sheep generally, but in particular it is useful for the dipping of lambing flocks. It is advocated that one dip be given immediately prior to lambing and another after about three weeks. For lambs a derris dust is used; this was suggested by Mr. Lyle Stewart of King's College, Newcastle, and it has been tested out on a large scale by him. It gives satisfactory protection for about a fortnight. The harmlessness of derris (except as a fish poison) makes it a useful substance for frequent dipping of sheep where it is desired to reduce a tick infestation by using sheep as trap animals.

The losses due to sheep maggots can be classed under two main heads: the direct loss of meat caused by death or loss of condition; the indirect loss due to the labour involved in looking for and cleaning up infested or dirty sheep. The chief culprit in Britain is the 'green-bottle', *Lucilia sericata* Mg., but recent work has shown that other blowflies attack sheep in certain circumstances.

Before maggots can develop on sheep, two conditions are necessary: (1) the fly must be attracted to lay in the fleece; (2) the environment must be suitable for the development of the eggs and larvæ. Various putrefying materials attract *L. sericata* to oviposit on live sheep in the field; also, ammonium carbonate, indole or skatol, all typical products of putrefaction. These materials only attract gravid females of *L. sericata*, and they are only effective in conjunction with live sheep, which supply a second essential factor. The limiting factor for the growth of maggots in the fleece is moisture. At the temperature of the sheep's skin, blow-fly eggs and larvæ cannot survive unless the humidity approaches saturation. The relative humidity of the basal fleece air is normally too low for the establishment of myiasis; it is below 50 per cent in dry weather and seldom exceeds 70 per cent after rain.

The majority of strikes occur in the tail region, as wool soiled with loose dung or urine supplies the conditions necessary for maggots. However, strike is quite common in clean wool on the back, where moist conditions may be due to penetration of the fleece by rain or excessive secretion by the skin glands. One method of control is the prevention of the development of a susceptible area. 'Crutching' is a simple method of preventing strike in the tail region. This consists of shearing the wool away from the area around the tail so that this part keeps clean. Crutching is an established method in Australia and has given good results in experiments in North Wales; it keeps the sheep clean and free from maggots for about four weeks until the wool grows again. Unfortunately, there is a great deal of prejudice against the method on account of its effect on the appearance of the sheep.

Advances in chemical control have been made possible by this work on susceptibility, repellents being tested by making sheep attractive with indole, larvicides by an experimental method of producing myiasis (by placing eggs or young larvæ under a pad of moist cotton, wool in the fleece). As maggot flies are strongly attracted to sheep, repellents have only a limited value. The fly dips in most general use are arsenical mixtures which act mainly through larvicidal action. For preventing maggots, it is the arsenic close to the skin which is effective, and this soon becomes reduced in amount, not by leaching with rain, but by the growth of new wool. Calomel has recently been found to be a promising material for preventing maggot infestation; it acts against the egg stage, the active principle being apparently mercury vapour. Calomel may be too expensive for dipping purposes, but should prove useful as an ingredient of preventive dusts and maggot dressings.

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* An article based on the following papers read at the annual general meeting of the Association of Applied Biologists on February 14, 1941.

"Recent work on the Sheep Tick and its bearing on control Measures", by Dr. J. McLeod.

"Recent work on the Sheep Maggot problem", by Dr. R. P. Hobson.

"Some practical aspects of the Sheep Blowfly Problem", by Dr. I. Thomas.

The presence of dung and urine in the dip may seriously impair its protective action. Suint, the water-soluble fraction of the fleece, is a further contaminant which may be more important. Suint contains a large proportion of soap; this dissolves in the dipping fluid and completely changes its physical properties, the surface tension falling appreciably. When much suint has accumulated in the dip, the retention of arsenic by the fleece is reduced and the immunity to artificial maggot infestation is decreased; these observations may explain the poor results often obtained when large numbers of sheep are dipped without changing the bath.

With regard to the treatment of infested sheep, further information is required about the breeding habits of the fly. If the sheep blow-fly population is derived mainly from live sheep, and not from carrion, then the first essential of a good dressing is the killing of maggots. It should also promote rapid healing and protect the wound against re-infestation.

In a problem of this nature there are two main avenues of attack: the host might be made immune or very resistant, or the pest might be greatly reduced or exterminated. Work in Britain has been concentrated mainly on chemical means of protecting the host by the use of dips. Jetting has been tried in Scotland, but protective dusts have not been experimented with on a large scale. The control measures at present available to the farmer are dipping and crutching. Indirectly, the prevention of scouring in sheep by good shepherding and the use of anthelminthics, is important.

Our knowledge regarding the ecology of the sheep blowfly in Britain lags very much behind the biochemical work on the maggots and the susceptibility of the host. We know practically nothing about sheep blowfly populations or the ecological factors governing them. Perhaps the most pressing need is for knowledge of carrion-infesting flies, in particular the question of competition. Important practical recommendations resulted from such a study in Australia.

This unsatisfactory position is considered to be due to the facts that: (1) the farmer, not realizing how serious are the losses caused by sheep blowfly, has not pressed for control measures; (2) the subject is not one normally dealt with by either the veterinary investigation officer or the advisory entomologist; (3) money for this ecological work has not been available; (4) failure adequately to carry the results of present research over to the farmer.

THE CAMPBELTOWN RAISED BEACH AND ITS CONTAINED STONE INDUSTRY*

BY DR. W. J. MCCALLIEN AND A. D. LACAILLE

THE flint implements of Campbeltown are well known. The original discovery was made in the deposits of the so-called 25-ft. raised beach by a local naturalist, Alexander Gray, in 1894. The Abbé H. Breuil described and discussed them in his classic paper, "The Pre-Neolithic Industries of Scotland" (*Proc. Soc. Ant. Scot.*, **56**, 261–81; 1921–22).

As many diverging views have since been expressed on these artefacts, excavations were recently undertaken to determine their stratigraphical situation and cultural age, a site in the post-glacial raised beach, some 35 ft. above ordnance datum, near the Albyn Distillery, Campbeltown, being selected for exploration. The work yielded 1,235 objects attesting man's attention. Of these 724 were definable artefacts, 559 being of flint (the raw material imported from Ireland), 157 of quartz and 8 of schistose grit. Many are heat-crackled, a feature commonest among the waste which indicates their derivation from an occupation-site. The conditions of discovery are generally similar to those of previous finds in that the artefacts were found distributed throughout the upper part of the beach deposits, although locally they were concentrated.

The components of the Campbeltown stone industries constitute the earliest evidence of the colonization of this part of Scotland. Originating from sites occupied on the shore during the time of rising sea-level in the early post-glacial period, they were incorporated into the beach formation during the emergence which followed.

The present study now enables us to determine a closer connexion between the industries of the equivalent raised beach on the Scottish and Irish sides of the North Channel. The Upper Palæolithic tradition so often stressed as being strong in the Argyll beach industry is not the only influence which left a mark on the stone products of the settlers. A faint Azilian strain appears in some steep round scrapers, while Tardenoisian influence is manifested by some artefacts, including that significant cultural index the micro-burin. The infiltration of Baltic Forest Culture is also suggested by a few objects, a small pick being particularly significant. On the other hand, some tool-forms, such as the "Larne pick", previously unknown outside Ireland are now seen to have a place in Scotland.

This new Campbeltown series of implements, belonging to what is essentially a fine blade industry, compares strictly with those of the Antrim beach assignable to the Early Atlantic climatic period and to Early Mesolithic culture. The Campbeltown industry is equated with Movius's Horizon 2 (Early Larnian) at Cushendun (*Proc. Roy. Irish Acad.*, **46**, C.I., 1–84; 1940). The Campbeltown group, however, including gravers, micro-burins, trimmed and obliquely truncated flakes abruptly retouched, and a pick, is more comprehensive and advanced culturally than its close counterpart across the North Channel.

The conclusion is reached that (*a*) from various pre-Neolithic elements the beach people developed a provincial culture of their own, (*b*) Tardenoisian methods of implement manufacture had reached

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*Summary of a paper read to the Society of Antiquaries of Scotland on February 22.

Scotland earlier than was thought, and (*c*) the influence of Baltic Forest Culture was more widespread in Scotland, both in geographical distribution and duration in time than has generally been held to be the case.

So far, only the more complex Antrim raised beach provides evidence of the evolution of the lithic element in the pre-Neolithic culture which flourished on the shores of south-western Scotland and north-eastern Ireland, but there exist indications to suggest that future inquiries in Scotland will afford analogies. The Campbeltown Early Mesolithic industry must antedate the advanced bone and antler industries from the Argyll shell-mounds and caves, the situation of which points to occupation during Late Atlantic times following the maximum submergence. This is possibly equatable with the Littorina transgression of the Baltic. In Baltic chronology, which cannot yet be applied with certainty to Scotland, the period of the Littorina raised beach may be taken as 5000–2500 B.C., the maximum transgression in Denmark taking place about 4500 B.C.

EARLY MATERIA MEDICA CABINETS

As a quiet and pleasing relief from topics bearing upon the War, Mr. E. Saville Peck took as the subject of his lecture at the February scientific meeting of the Pharmaceutical Society "Three Early Materia Medica Cabinets in Cambridge".

The collections described, namely, those of J. P. Vigani, John Addenbrooke and William Heberden are of special interest for various reasons, but notably because they mark the time when the atmosphere of indifference to medical teaching which had hitherto prevailed at Cambridge began to be dispelled. Vigani, a native of Verona, who had taught chemistry in Cambridge for twenty years, was invested with the title of professor of chemistry in 1703, and it would seem that a chest containing more than six hundred specimens of materia medica, which was found in 1922 under the staircase of the library of Queens' College, was the one from which he lectured.

Mr. Peck has told, on a previous occasion, of the evidence on which he based his belief, and his description of the contents of the chest, which was published some years ago, forms a useful addition to the literature of drugs.

John Addenbrooke's chest, now in St. Catherine's Library, contains, besides the drugs, many geological specimens which he collected and labelled when in his undergraduate days he used "to range the circumjacent country, Cherryhinton, Grantchester and Trumpington and searched the chalk pits and moors for fossils and simples". The chest itself is made of deal and is much the same in shape as a flat-topped writing desk of the present day, having a frog hole in the middle, drawers all the way down and also at the back of the recess; each drawer is divided by wooden partitions into compartments of about 3 inches square. There are about twenty such drawers containing a fine collection of materia medica. Perhaps the best of these collections are the drawers containing gums, resins and the like, the drawer of roots and rhizomes and another containing barks and woods, and still another filled with seeds. Some of these specimens were labelled by Addenbrooke himself.

Incidentally, there is a fine specimen of coffee berries in Addenbrooke's chest; this "drug" had but recently been introduced, and a few years earlier, in 1680, had been described as being "most useless, since it serves neither for nourishment nor debauchery". Among other drugs introduced in the seventeenth century and specimens of which Addenbrooke collected, were jalap, serpentaria, calumba and balsam of Tolu.

The third chest described by Mr. Peck was that of William Heberden, who was admitted a sizar of St. John's in 1724, and was made a medical fellow in 1734, proceeding to the degree of M.D. in 1739. He gave an annual course of lectures in materia medica, and made good use of his knowledge of the classics to adorn them; the collection of materia medica which he had formed to illustrate his lectures he presented to his college when he left Cambridge to practise in London, where among his patients was Dr. Johnson. Boswell relates that when he was asked what physician he had sent for, he replied, "Dr. Heberden, ultimum Romanorum".

Heberden's cabinet is made of oak and contains in the upper portion twenty-eight drawers and below a cupboard with two shelves. The contents are noted in a manuscript catalogue of July 10, 1751. The three cabinets described have many points of similarity; all three contain almost identical substances, most of which are mentioned in Culpeper's Herbal and the London Pharmacopœia of the time. They are contained in little paper trays folded in similar fashion and placed in the various positions in the drawers.

Cambridge is fortunate in possessing such treasures and, as Mr. Peck acknowledged, pharmacists are grateful to the Colleges for the care they have taken of them for more than two centuries.

RECOGNITION OF COLOURED LIGHT SIGNALS

A PAPER was read to the Illuminating Engineering Society on February 11 by J. G. Holmes on the recognition of coloured light signals. The apparatus described in the first part of the paper was made to provide a spot of coloured light suitable for observation under conditions comparable with night signalling, and capable of variation through a wide range of colours, the energy distributions of which were similar to those of the usual signalling colours.

The apparatus is similar to the Donaldson colorimeter, but with eleven primaries. Eleven beams of light from a common light source pass through coloured filters and through adjustable apertures, before being mixed in an integrator, and any required colour is obtained by combining the appropriate amounts of the three nearest primary beams. The range of colours covers the spectrum from extreme red to emerald green (550 mm.) and the area enclosed by this spectrum, and turquoise, royal blue, and purple with provision for particular consideration of white and yellow. The calibration was done with great care with a view of eliminating relative error between similar colours and to allow of statistical examination of results.

The test colours were obtained by the use of stencils selecting the primary beams, which gave 256 points on the colour chart, all being of the same luminous intensity and brightness, and each having a closely similar energy distribution to that which would be given by the corresponding colour filter, and would be used in practice.

The method of experiment was to show the 256 colours in random succession to an observer who was asked to give one of the simple names, red, yellow, green, blue, purple or white—to each test colour. This experiment was repeated for fifty observers, all of normal colour vision, and thus the number of times that any particular colour was given a particular name was found. Contours were then drawn on the colour chart showing the percentage frequency with which those simple names occurred over the whole area covered by the apparatus. A diagram is given showing the distribution of the names 'red' and 'green' for an illumination of 10 sea-mile candles at the observer. The experiment was further repeated with six observers selected to give average results, each making three observations at four different illumination levels, and with several different choices of names such as red, green, or white, and red, yellow, green or white and so on, and contours were drawn for each set of conditions. Experiments were carried out on the effect of a comparison light, light adaptation, and presbyopic vision, and altogether some 43,000 observations have been analysed and are represented in the diagrams.

The results are difficult to summarize, as the experiments were intended as a contribution to knowledge of colour recognition rather than a complete statement of the distribution of colour names. Red is the ideal signalling colour, being easily produced and yet recognized down to the lowest illuminations, even when not fully saturated. Green is satisfactory under usual conditions, but must be considerably restricted if blue is also used for signalling. Blue and purple cannot be regarded as satisfactory, the former requiring very high intensity and the latter depending on the dichromatic aberrations in the eye. Yellow and white are satisfactory if used separately, but they cannot be used together unless the white approximates to daylight.

It may be noted that whereas yellow has often been thought unsatisfactory, because of the confusion with white, the case is really that many whites are unsatisfactory because they are themselves too yellow. No significant difference was found between monochromatic sodium light and the equivalent lamp and filter combination. Presbyopic vision and light adaptation both assisted the recognition of blue and purple signals.

The paper concludes with a calculation of the optimum transmission factor for green colour filters based on the results obtained, and gives results which are reasonably consistent with those adopted in practice.

FORTHCOMING EVENTS

(Meeting marked with an asterisk is open to the public.)

Monday, April 7

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Mr. W. E. Doran: "The Ouse Drainage Problem".

Tuesday, April 8

CHADWICK PUBLIC LECTURE (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 2.30 p.m.—"Air Raid Shelters—Design and Construction, with special reference to Hygienic Considerations" (Dr. S. L. Wright: "Hygienic Considerations"; Mr. Phillip O. Reece: "Design and Construction").*

ILLUMINATING ENGINEERING SOCIETY (at the E.L.M.A. Lighting Service Bureau, 2 Savoy Hill, London, W.C.2), at 2.30 p.m.—Dr. J. W. T. Walsh: "The Measurement or Gauging of Low Values of Illumination and Brightness"; Mr. J. S. Dow: "Visibility by White and Coloured Light".

Wednesday, April 9

SOCIETY OF CHEMICAL INDUSTRY (at British Medical Association House, Tavistock Square, London, W.C.1), at 11 a.m.—Discussion on "Vegetables as Food".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

WOMAN GRADUATE IN PHYSICS—The Clerk to the Governors, South-East Essex Technical College, Longbridge Road, Dagenham (April 9).

PRINCIPAL OF THE CHISWICK POLYTECHNIC—The Secretary (T), Middlesex Education Committee, Acton County School, Gunnersbury Lane, London, W.3 (April 16).

PRINCIPAL OF THE ENFIELD TECHNICAL COLLEGE—The Secretary (T), Middlesex Education Committee, Acton County School, Gunnersbury Lane, London, W.3 (April 16).

PRINCIPAL OF THE TOTTENHAM TECHNICAL COLLEGE—The Secretary (T), Middlesex Education Committee, Acton County School, Gunnersbury Lane, London, W.3 (April 16).

PRINCIPAL OF LURGAN TECHNICAL INSTITUTE—Mr. H. O. Armstrong, Technical Institute, Lurgan, Co. Armagh (April 21).

TEACHER (MAN) OF ENGINEERING AND MATHEMATICS at the Grimsby Technical College—The Director of Education, Education Offices, Eleanor Street, Grimsby (April 30).

TEACHER OF MINING AND ENGINEERING SUBJECTS—The Principal, Technical Institute, Canterbury.

PROFESSOR OF PATHOLOGY and a PROFESSOR OF PHYSIOLOGY—The Secretary, University College, Cork.

ENGINEER for the Public Works Department of the Government of Sierra Leone—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9552).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

British Electrical and Allied Industries Research Association. Technical Report, Reference W/T4: Improvement of Load Factor in Farm Grinding. By W. H. Cashmore and C. A. Cameron Brown. Pp. 30. (London: British Electrical and Allied Industries Research Association.) 2*s*. 6*d*. net. [63

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 802, Vol. 239: X-Ray Crystallography and the Chemistry of the Steroids, Part 1. By J. D. Bernal, Dorothy Crowfoot and I. Fankuchen. Pp. 135–182. 7*s*. 6*d*. Series B: Biological Sciences. No. 574, Vol. 230: The Colours of the Plumose anemone *Metridium senile* (L.). By D. L. Fox and C. L. A. Pantin. Pp. 415–450. 5*s*. 6*d*. No. 575, Vol. 230: On the Bicoecidæ, a Family of Colourless Flagellates. By L. E. R. Picken. Pp. 451–474. 4*s*. (London: Cambridge University Press.) [63

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences.) Vol. 61, Part 1, No. 1: On Hamilton's Principal Function in Quantum Mechanics. By E. T. Whittaker. Pp. 19. 1*s*. 7*d*. Vol. 61, Part 1, No. 2: The Van der Walls Force between a Proton and a Hydrogen Atom. By Dr. C. A. Coulson. Pp. 20–25. 6*d*. Vol. 61, Part 1, No. 3: Reciprocity, Part 5: Reciprocal Spinor Functions. By Dr. Klaus Fuchs. Pp. 26–36. 1*s*. (Edinburgh and London: Oliver and Boyd.) [63

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ASPECTS OF RECONSTRUCTION—II

A SPECIAL committee of the Town Planning Institute has been investigating the problem of compensation and betterment in relation to town planning*. A review of existing legislation on compensation and betterment and the acquisition of land by public authorities, including a survey of foreign practice, satisfied the Committee that essential planning, and particularly replanning, cannot be carried out effectively under the existing legislation; nor under any development of a system which involves the separate assessment of compensation and betterment in respect to each individual interest.

This Committee does not find that existing legislation is, in general, unjust to either private or public interests, although it recommends certain amendments which should mitigate some existing anomalies. The chief obstacle to the achievement of positive results by statutory planning is the multiplicity and variety of interests that hamper it on all sides, each of which has to be separately valued and taken into account. Consequently, where private ownerships present an obstacle to securing planned development, redevelopment or conservation on an economical basis, essential simplification and equity are likely to be best achieved by the wholesale purchase of areas by planning authorities. To facilitate this, the Committee recommends an amendment to the Town and Country Planning Act, giving powers to authorities to buy land required "for securing the preservation of existing buildings or other objects of architectural, historic or artistic interest or for the protection or improvement of agriculture". It is pointed out how essential it is that all publicly owned land should be subject to planning control under town and country planning schemes, and recommends that all land in the country should be planned and valued by one authority, on uniform principles and at one time, at intervals, for example, of five years, thus affording a datum time for the assessment of compensation or betterment.

These recommendations, the Committee considers, would secure rural preservation on a sound and fair economic basis, and check extravagant claims for schemes for the redevelopment of developed areas. It urges that creation of a National Planning Board with vested interests in development rights would be fatal, unless such rights were subject to planning control. It also recommends that land developers should be required, without compensation, to allocate not more than 35 per cent of the land for streets and open spaces, or instead to make a cash payment, such money to be used by the planning authority to provide open spaces in or adjacent to the land.

The Committee considers that mineral working is at present amply protected by the Town and Country Planning Act, but it strongly recommends that the owner should not be allowed to have the best of both worlds, but should be required to choose between mineral value and building value. It also proposes an amendment to secure that when surface minerals have been exploited no building value shall attach to the land, which will in consequence be available for open-space uses or for agriculture or afforestation at a value which makes such uses possible. It recommends the abolition of the disparity between compensation and betterment, and urges that the problem of the future will be to cope with the migration of population, not with its increase. The foundation of satellite towns would involve the occupation of compact areas of rural land, but in that case enough land should be purchased for the town and its agricultural belt, so that the question of claims for betterment would not arise.

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* Town and Country Planning: Compensation and Betterment. Pp. 60. (Town Planning Institute, 11 Arundel Street, London, W.C.2).

The announcement that the Ministry of Works and Building has already set up an expert committee under Mr. Justice Uthwatt to examine the question of compensation and the recovery of betterment indicates that Lord Reith is already taking steps to deal with these problems. There is, in fact, already a wealth of material available for the assistance of the Minister of Works and Building, but even the most urgent demands for rebuilding require study and must conform to some plan if opportunities are not to be lost and fresh obstacles placed in the way of building more fitting and dignified cities where destruction has been concentrated. Unless at least the principles and outlines of an adequate plan are rapidly determined, there is grave danger that the necessity of physical rebuilding may in places jeopardize local if not national plans.

Scarcely less urgent are the second broad group of problems of reconstruction—what may be termed the rehabilitation problems. We shall be faced with the demobilization of large numbers of those in the armed and auxiliary forces and their return to peace-time employments. Industries that have swollen during the War to gigantic proportions will require relief from the troubles that may follow from surplus capacity. There will be other industries, which have had to close down during the War, to be restored to profitability. It would be optimistic indeed to assume that there will not be a new crop of depressed industries requiring care. Only foresight and careful investigation now can avoid severe dislocation and hardship when we begin to make the change-over from war to peace production.

There is no reason to be unduly pessimistic about our ability to surmount the difficulties with more success than last time, if forethought is given to the problems. The decline in our export trade, for example, which was such a stubborn element in our economic readjustment after 1918, is unlikely, in view of the much smaller part of export in our total economy to-day, to have the same effect on our general prosperity, even if it suffers as much. Moreover, we have advanced further in control of the trade cycle than we had in 1919. If we have a plan of campaign, we have a chance to control the post-War slump.

Overlapping with the remobilization of all our energies for the purposes of peaceful progress and orderly development are the problems involved in developing a new economic order and eliminating the frustration which has been responsible for the conditions leading up to the War, and removing the weaknesses which war has revealed. The development of our educational system and social services, the intensification of the attack on malnutrition and disease, the elimination of ugliness in our towns and replacement of the hovels that remain by worthy homes, demand creative thought as well as courage and determination to overcome whatever obstacles prejudice, vested interests, shortsightedness or ignorance may put in the way.

Success of such a policy and measures involves the fearless acceptance of the lessons of the War. No community can be exposed to such a strain as modern warfare imposes without some weaknesses in structure or organization being exposed. Underlying the concern which has recently been expressed at the position of war-production is a growing realization of how completely unprepared for war our industry was, how grave a handicap we must always labour under if, after every war, we show such complete confidence in eternal peace. Whatever the size of the standing forces we find it advisable to maintain after the present War, we shall be blind indeed to the lessons of 1936–40 if we do not maintain an embryo of munition industries, capable of rapid expansion, if we do not give all our citizens a minimum of training in their war-time duties, and if we do not make certain that stocks of the essential materials, adequately protected, are always kept in Great Britain.

A further weakness which the War has revealed is the apparent failure to train up a sufficient supply of men of ability to lead the nation. The courage, skill and character of such sections of the nation as the pilots of the Royal Air Force suggest the question whether our peace-time social structure really takes the advantage it might of such men. The lack of ability at the top may be due to some defect or bottleneck in the system of selection, and our educational system must be overhauled from the social point of view to determine whether it is at fault not so much on the pedagogical as on the social side.

Along with educational policy and system, national industrial policy requires overhaul. We have slipped from a *laisser-faire* system into one of State-encouraged cartels, not from deliberate choice but in a fit of absentmindedness. The process has been accentuated during the War by the policy of selecting the controllers, and economic reconstruction will be impossible unless we first examine the system to determine whether it is united to achieve that combination of progress with security that should be the economic objective of a dynamic democracy. If we are on the wrong road, the demobilization of war-time controls will offer us our last chance to change course.

These are only some of the major questions which the stress and strain of war have brought before us and to which answers are being urgently demanded. There are many others—the wide field of building the nation's health, the readjustment of town and country life, especially for children, forced upon us by evacuation, and the new conception of colonial responsibilities to which the White Paper of a year ago gave expression. Here will be found the fields for Mr. Greenwood to plan in advance, as Mr. Churchill said in the recent debate, "a number of large practical steps which it is indispensable to take if our society is to move forward". The immensity of the task should be an inspiration and not a deterrent. The intensity of our concentration at the moment on the full utilization and proper distribution of the powers of production is providing us with the power to realize such plans when hostilities terminate. The expansion of industry dictated by the requirements of war is already, by the problems it creates, shaping the plan of future reconstruction. If that plan is worked out and set in motion, it will eventually, with the minimum of friction and delay, absorb the resources of production which will be released when the War comes to an end.

If therefore the call is to hard thinking and concrete planning, to the devising of appropriate machinery, drawing on the widest and wisest experience and ablest minds of the nation, it is equally one to co-operation. Mr. Churchill's plea for a continuance of national and political unity during the period immediately after the War is a sign that the Government is thinking ahead. Already it is becoming widely realized that the end of the War will be a signal, not to return to idleness and complacency, but to undertake great things. If that call is heeded, if professional men unite to bring a spirit of disinterested service, impartial inquiry and constructive thought into all those fields where their special knowledge or experience is of service, we need not despair of our ability to relieve distress and bridge the gap between war and peace, and to organize that full employment of resources which can both repair the ravages of war and usher in an ampler and nobler world order worthy of the sacrifices now being made.

RELATIONSHIP OF PURE AND APPLIED BIOLOGY

THE great number and the immediacy of applied biological problems in this time of war, coupled with the embarrassingly small use made of pure biologists by those in authority, has raised acutely the problem of the relationship of pure and applied biology*. To a certain extent academic botanists and zoologists are themselves to blame for their apparent uselessness, since for long they have tended to hold themselves aloof from applied work and have, indeed, sometimes decried not only its intellectual status but even its scientific value.

This superficial and arbitrary division of biology into 'pure' and 'applied' is a very unfortunate development of comparatively recent times. For Robert Boyle, true science was such knowledge "as hath a tendency to use", and for Francis Bacon "such philosophy as . . . shall be operative to the endowment and betterment of man's life". So recently as the days of Pasteur there was neither 'pure' nor 'applied'; there was simply biology, botanists and zoologists increasing knowledge and adding to the sum of human welfare. But in the thirty years or so overlapping the birth of this century, a series of trends and conditions, which in themselves make a fascinating history, led to the professionalization of biology; by the early 1900's most university professors had become 'pure' biologists, and by the 1920's they had become narrow specialists in one or another branch of pure biology. Such a condition was, clearly, far from satisfactory.

So artificial, so one-sided and extreme was this development, that it stimulated a reactive movement. In 1904 the Association of Applied Biologists was founded, and although of small numbers and living a somewhat precarious existence in its early years, it survived to become the focus of a great development of application and research. In 1914 it established the *Annals of Applied Biology*. In 1909 the Development Fund Act was passed, and during the next fifteen years practically the whole of our present organization for applied biological research and the application of biological knowledge came into being. But the enormous growth and the very success of this organization, its wide range and the scale of its activities, only accentuated the distinction between pure and applied biology. The pure workers, fearful lest these Goths and Vandals storm their scholastic defences, or even absorb them, tended to shut themselves up like beleaguered garrisons within their ivory towers, and to develop a specialized and self-justificatory life of their own remote from the moil and toil of common life. So, to-day, there are the pure biologists holding the academic posts, and the others, the applied biologists, holding posts ranging from research institutes to commercial firms. Research institutes may be attached to universities, but, even so, their staffs are often regarded as slightly tainted.

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* Discussed at a joint meeting of the Association of Applied Biologists and the Society for Experimental Biology on Friday, March 28, 1941. The opening addresses were given by Prof. P. A. Buxton and Prof. W. B. Brierley. See also pp. 436 and 439 of this issue.

The whole gamut of appointments from research institutes to industry is, of course, staffed by men and women trained in the universities. But, unfortunately, this is a one-way traffic system, and only in the rarest cases is there appointment of men from the applied side to the university staffs. During the last ten years the number of men who have returned to the fold can almost be counted on one hand. So, again the credo of academic men is accentuated, that they are the fount and inspiration not only of all knowledge but also of all application. As, year by year, successive vintages of students are conditioned to this belief by their academic teachers, by their academic curricula, and by every academic influence in a most formative period of their lives, so this myth lives on, rarely questioned. Occasionally, a mouse-like squeak of dissent arises, but the state of academic auto-hypnosis is little disturbed. In this connexion, academic authorities might well consider overhauling their system of appointments committees. Too often, at any rate, in the case of biology, those appointed to consider applications for academic posts are out of the field of modern research and biological advancement and should not, therefore, be put in the all-important position of deciding the future policy of biological teaching and research through their choice of candidate. It would be a decided advantage if applied research, in the form of a biologist or biologists from an industrial or agricultural institute, were more fully represented on those committees appointed to settle appointments to senior academic positions.

Now the danger of this situation is that there is no reciprocal fertilization: applied biology receives stimulus and inspiration from research in pure biology, but the academic workers not only shut themselves off from any reverse stimulus and inspiration, but often actually seem to take pride in their isolation, a state of folly that the most casual reading of the history of science should expose. Yet their almost pathological fear of the tainting or even absorption of pure science by applied science colours their vision: they feel themselves to be crusaders defending the sanctity of pure science, which for them possesses almost a mystical quality.

The psychological motivations in this situation are fairly clear, but its immediate practical importance lies in its repercussions, the influence this situation must have on biology as a scientific discipline, on biology as a vocational training for teaching, for agriculture and horticulture, for industry and commerce, on biology as an avenue for the intellectual development of the individual, and on biology as a primary constructive factor in social life and the progress of civilization. What all biologists would deplore is that pure biology, defending its virginity, should lapse into barren spinsterhood.

A question very ripe for the asking is whether this dichotomy or antithesis of pure and applied biology serves any good purpose, or whether, recognizing its falsity, it is not imperative to attempt a reconstruction and unification of the science. Certainly if our scientific societies and our scientific journals were reconstructed and unified, we should all be very much better off financially, there would be an enormous saving of time and energy, and scientific publication and the professional organization of biology could be enormously improved. From the point of view of the research development of the subject the advantages of such a unification of the pure and applied aspects are obvious. Such a unification does not, of course, imply that the economic biologist should immediately investigate fundamental problems, or that the theoretical biologist should undertake a modicum of commercial practice. It does, however, imply, especially on the part of the pure biologist, very much more give and take, much more understanding and sympathy, and a greater exercise of imagination in his contacts with mother earth. It would, for example, be perfectly simple to arrange exchange appointments or periods of service between members of university staffs and those of research institutes, or one or another existing applied biological organization. The cross fertilizing influence of such interchange on both teaching and research would be immense.

It further implies that the academic curricula and system of training should not be regarded solely as a logical discipline, justified purely by intellectual criteria, but that attention should equally be given to biology as a factor in cultural and social life. A university degree in botany or zoology should not only be the hallmark of a competent botanist or zoologist, but it should also be the hallmark of an educated man, one capable of visualizing his biology not only as a logical system in a perspective of scientific values, but also as a means towards a fuller life in a more richly endowed social community. Pure science, guiding the student to a logical intellectualist ideal, leaves him facing the mental apparatus and not the concrete problems of life as life is lived in the world in his time. Biological teaching is only adequate when it brings biology into relation with everyday life. Biology for the biologist is totally objectionable ; biological results show their highest value by becoming the property of the people. Our traditional methods of biological education are, at best, too much occupied with intellectual analysis, at worst, too much occupied with the acquirement of formularized information ; we emphasize abstract formulations and neglect their wider human applications. Praiseworthy efforts to change this are now being made by the British Social Hygiene Council, especially through its Educational Advisory Board.

Applied biology is an integral part of the vital thought and culture of our age and, as such, must be incorporated in any constructive system of higher education. The way to accomplish this is not by the insertion of so many additional courses on the several aspects of applied biology into an already overladen curriculum : students already suffer not only from intellectual strabismus, but also from chronic mental indigestion. An infinitely better way, perhaps the only satisfactory way, is to effect a thorough reconstruction of our curricula, simplifying, condensing, and pruning, eliminating all the venerable accumulations, the merely traditionalist and sentimental moieties, the moribund and dead matter, the intellectual vested interests, the fetishes and shibboleths, exercising the most stringent selection, and balancing them throughout with a more luminous vision and a more prospective imagination. For more than a generation biological teaching has been strung along the threads of logical evolutionary principles, but it should be patterned as a fabric of which the warp is the principles of logic and the woof the humane relationships of biology.

It is usually objected that all biologists, but perhaps more especially those whose leaning is towards application, must be given "a sound fundamental training", and it is always assumed that this is given by our present system. Whether this system is the only one which can do this, whether, indeed, it is the best system for this purpose, is never raised in question. Now all biologists, pure and applied, will agree that in his training a student should attain certain values, and these values are what is usually implied when the phrase "sound fundamental training" is used. But are these values anything more than the acquirement of the scientific outlook and attitude, familiarity with scientific methodology and technique, knowledge of analytic data within a recognized field and capacity to evaluate such data, and appreciation of logical scientific principles with facility in their exemplification ? Does a "sound fundamental training" imply more than this and, if not, cannot these values be achieved better from biology presented as a unified and patterned fabric of development than from biology presented purely as a logical system in the traditionalist way ?

Life is wider than logic, and no scientific system is sufficient unto itself. We want our students to be not merely experts in some particular branch of science, but also experts in the art and understanding of life. The improvement of natural knowledge for use is a duty as instant as that of improving natural knowledge for discovery. Science is not merely a channel of escape to a private and self-sufficient world, to be justified by remote and abstract criteria ; science is a social function, with social roots and social consequences, and if our science, if biology, is to live on as a vital human force, it must ever keep essential human values in view, and it must justify its existence in the world by its contributions to it.

FERTILITY, GROWTH AND BREEDING OF FARM ANIMALS

Farm Animals:
their Breeding, Growth and Inheritance. By Dr. John Hammond. Pp. viii+199. (London: Edward Arnold and Co., 1940.) 14*s*. net.

AMONG the authors of recent texts on animal breeding, there are no armchair philosophers who, retiring from active research, have time to write a comprehensive and well-balanced treatment of the whole subject. In the distant future, it is to be hoped, Dr. Hammond will fill this rôle. Meanwhile he has provided a short account of his more immediate interests in the form of two series of lectures—the one on fertility and growth and the other on genetics in relation to the practical problems of breeding farm animals. Were it not for the second and shorter part, the contents might well be described as a résumé of recent Cambridge experiments on fertility and growth. Problems of fertility, artificial insemination and proportional growth in all the main classes of farm livestock have been discussed in the light of research which Dr. Hammond has himself carried out or inspired. The work on fertility has given promise of greater breeding efficiency, particularly in horses, which are notoriously unreliable. Besides a very clear and concise account of the ordinary processes of reproduction and the diagnosis of pregnancy, there are hints of future developments in hormone therapy. The possibilities with sheep in this direction are notable since they include raising, where desired, the numbers of lambs born, and extending the mating season. Closely linked with the subject of fertility, of course, is that of artificial insemination, the most effective use of which presupposes a thorough understanding of the natural process. No attempt has been made to advocate artificial insemination on a grand scale, but those whose special circumstances require it will find here much good practical instruction.

The economic pressure which has focused attention on the question of quality in meat will be familiar to most readers. Equally familiar no doubt will be the fruits of Dr. Hammond's efforts in this field. Here, in small compass, is developed the principle that changes in the proportions of the organs and tissues follow a definite course during growth. It is further shown that this course, and therefore carcass quality, can be modified by either raising or lowering the plane of nutrition. By implication, the right weight at which meat animals should be slaughtered and the appropriate rates of live-weight gain at various stages of growth can be determined. Just how much control can be usefully exercised without conflicting with other considerations, such as the periodic nature of the supply of certain feeding stuffs, or the varying response of different individuals to the same treatment, is unfortunately not yet clear. Rapid growth-rate up to weaning time, however, is usually desirable, and this is in line with the advantages of improving intra-uterine nutrition and milk production.

The second part of the book will interest geneticists because Dr. Hammond holds independent views on certain aspects of heredity. He suggests repeatedly, for example, that genes may be classified either as unit factors governing the appearance of fancy points or deleterious recessives, or as multiple factors which control variation in quantitative characters and tend to be dominant. The impression is given that mutations affect mainly the unit factors, and are nearly always worthless. Even the polled character is doubtful, since on p. 135 it is not mentioned as having any semblance of real economic value, whereas on p. 149 it is pointed out that there is a need for a polled Shorthorn breed to save a lot of time and money now spent on dehorning beef cattle. While no one is likely to deny that the bulk of obvious mutations are useless to the breeder of commercial stock, such a simple classification of genes will be questioned. Furthermore, it is very doubtful whether there are any basic distinctions yet to be drawn regarding their behaviour in mutation or development.

These innovations might have been more impressive if they had not been accompanied by a number of dubious examples of the workings of heredity. Hernia in pigs, for example, is conveniently assumed to be a simple recessive (p. 146) although it is by no means certain that multiple factors are not involved. Again, on p. 142, grey colour is referred to as dominant to bay in horses although the genes concerned are not alleles; on p. 171, the sire and dam together are said to contribute half the germplasm to the offspring instead of half each, thus confusing the conception of parent-offspring correlation; and on p. 150, five generations of backcrossing are regarded as sufficient to achieve the transfer of a single gene from one breed to another, which is an over-simplification. Such inaccuracies, like the rather plentiful printing errors, might be accounted for by limitations of time or space. But underlying the more substantial departures from current genetic theory has been the feeling that random mutations are inadequate to account for the progress in livestock breeding, although in respect of conformation that progress is shown to be actually a hastening of the tempo of evolutionary trends. The creation of improved environments is therefore supposed to have a directive influence on the mutation of genes affecting productive qualities (but not of unit factor genes)—which recalls Lyssenko's attitude.

Many readers will still feel disinclined to discard the more orthodox theory of evolution, even for farm animals, until forced to by weight of evidence. The further contention that selection, to be effective, should be practised under the most favourable environmental conditions, although widely supported, is often misleading. Selection *under* these conditions is selection *for* them. The unqualified idea that the resulting animals can then be used readymade elsewhere appeals, just as something for nothing always does. Yet surely they can be used successfully for grading up poorer stock only at a price which may be the preliminary grading up of the environment, lowered carrying capacity, or reduced hardiness.

Fundamentally, however, Dr. Hammond's philosophy is very wise. As fast as environment can be improved, animals able to make the best use of it should be bred. Unhappily, livestock improvement often lacks impetus and guidance, and awaits the establishment of some practical means of short-circuiting the wearisome piling up of performance records. To that end, Dr. Hammond has rendered great service by clarifying obscure problems, and giving more specific direction to breeding efforts.

H. P. DONALD.

METABOLISM OF INORGANIC SUBSTANCES

Mineral Metabolism

By Dr. Alfred T. Shohl. (American Chemical Society Monograph Series, No. 82.) Pp. x+384. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 30*s*. net.

THE excitement of the race to establish the formulæ of vitamins has diverted interest from other branches of the science of nutrition; but now that so many vitamins have been synthesized, attention is turning more and more to the study of the metabolism of inorganic substances. Many elements are essential for growth, and, in a number of cases, the quantities required are no larger than the quantities of vitamins required, but there are still many obvious gaps in our knowledge of their action. The experimental methods developed for the study of vitamins may be applied to the study of mineral metabolism, but the practical problems are different; the isolation of the active principle, so important in the case of vitamins, is no problem at all, and the main initial difficulty is to devise diets from which the active principle is absent.

The appearance of an authoritative monograph on mineral metabolism will be widely welcomed. It contains as much information per page as anyone could wish, but it is not merely a catalogue of results, nor a summary of the opinions of others. It is a balanced review of the work done up to 1938. The bibliography, which contains about 1,200 references, is not intended to be exhaustive, and may, in certain cases, cause irritation by failing to give due credit to the first discoverer of new facts, but it will certainly enable anyone to obtain access to the literature.

Successive chapters are devoted to the mineral composition of the body, secretions and excretions, internal secretions, total base, chloride, ammonium and bicarbonate, calcium and magnesium, phosphorus, sulphur, iron, iodine, traces, water metabolism, anion-cation relationships, and mineral intakes, balances and requirements.

The field is a wide one, and is not all covered with equal thoroughness. Potassium, for example, receives less attention than many would like to see accorded to it, while calcium and phosphorus are more fully discussed.

Everyone will find in this book much that is interesting and stimulating. Among the elements on which attention has been focused in recent years are bromine, manganese, silicon, copper and zinc, all of which are normal constituents of animal tissues. Bromine has been found in particularly high concentrations in the anterior lobe of the pituitary gland; deficiency is said to cause death in the second generation of rats. The view that chloride and bromide are interchangeable in metabolism is rejected. Deficiency of manganese causes effects not unlike those of deficiency of vitamin E; male rats lose the use of their testes, and female rats produce young which do not survive. Both copper and cobalt play an important part in the formation of red blood corpuscles. Dr. Shohl's conclusion that zinc is an essential element has, of course, since been confirmed and explained by the discovery of its presence in carbonic anhydrase; which will add to the interest of experiments on deficiency of this element.

The publication of this book will help to stimulate work in fields where there is still much to discover.

J. H. GADDUM.

SCIENCE AND THE NATIONAL EFFORT*

BY THE RIGHT HON. LORD HANKEY, P.C., G.C.B., G.C.M.G., G.C.V.O.

THE present position of scientific help in the prosecution of the War has been built up on foundations well and truly laid before war broke out, when the three great pillars of the permanent civil research organization of the Government were the Department of Scientific and Industrial Research, the Medical Research Council and the Agricultural Research Council.

Similarly, on the defence side there were important research organizations in the Admiralty; the Ministry of Supply, which undertakes most of the research work for the War Office; the Air Ministry, which, however, has now handed over most of its research work to the Ministry of Aircraft Production; and the Ministry of Home Security, which occupies a position intermediate between the Service Departments and the Civil Departments. In addition there was a good deal of research in the Civil Departments.

Just six months ago, with the approval of the Prime Minister, the late Mr. Neville Chamberlain, as Lord President of the Council, set up a Scientific Advisory Committee. It was the last official act of his long career. He had given much thought to the subject and when I last saw him he spoke of it with infectious enthusiasm: a characteristic instance of his far-sighted statesmanship. I am now drawing on my six months' experience as chairman of the new Committee. I had better begin by explaining its status. Besides the chairman, the Committee consists of Sir Henry Dale (the president of the Royal Society), Prof. A. V. Hill, M.P., and Prof. A. C. G. Egerton (joint secretaries of the Royal Society), together with the secretaries of the Department of Scientific and Industrial Research (Sir Edward Appleton), the Medical Research Council (Sir Edward Mellanby), and the Agricultural Research Council (Sir Edwin Butler, who unfortunately had to resign on grounds of ill-health); the chairman of the latter Council, however, Sir Thomas Middleton, has attended many of the Committee's meetings. In addition, at the request of the Committee, the Lord President of the Council invited Sir William Bragg, the former president of the Royal Society, whose term of office expired shortly after the formation of the Committee, to serve as an additional member until he had completed a period of twelve months. The joint secretaries are Prof. W. W. C. Topley, a distinguished fellow of the Royal Society, with a colleague from the offices of the War Cabinet.

The Committee is in touch through the Royal Society with the great streams of scientific research and development; through the representatives of Government research with Government activities; and through the chairman and the Lord President, to whom the Committee reports, with the policy of the Government in these matters.

The question has been raised whether in constituting this Committee the Government has interpreted the term 'scientist' too narrowly. The reason for not including representatives of applied science was not a failure to appreciate its great importance to our war effort, but simply that the proposal did not fit into the Government's conception of the Scientific Advisory Committee. The Government had envisaged a small body with contacts with the whole of science, but not representing any particular section, to ensure the utmost use of science and men of science in the prosecution of the War. The representation of applied science with its many branches must have involved some enlargement of the Committee and would have altered the whole plan. The Government, however, is at present in touch with the professional societies concerned with a view to the possible establishment of a separate organization working in the field of applied science and in close touch with the Scientific Advisory Committee, and an announcement may be expected before long.

The Committee has devoted itself mainly to the contribution of science in the war and will continue to do so. Nevertheless, the importance of the eventual use of science in problems of reconstruction has not been overlooked, and the Committee is in touch with the Minister without Portfolio, who is in charge of these matters.

At its first meeting the Committee decided to prepare as a background for future work a survey of the scientific activities of Government Departments.

In addition to obtaining written reports, the directors of scientific research of each of the Departments engaged mainly in war work were invited in turn to tell the Committee something of their activities. Sometimes they were accompanied by staff officers of the Fighting Services, as representing the users of research.

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* From a statement before the House of Lords on April 2.

Owing to their secrecy, some of the subjects of discussion have to be confined to the smallest possible circle. To provide for this the Committee appointed a small Defence Services Panel composed of members who were already associated officially with secret Government research work.

In describing how far the assistance of men of science has been enlisted in the prosecution of the war, I shall return for a moment to what I called "the three great pillars of the permanent civil research organisations".

Thus the Department of Scientific and Industrial Research with its thirty-three advisory boards or committees, each dealing with a particular subject and each commanding the services of distinguished experts, disposes of a wealth of scientific talent. Their membership includes fifty-one fellows of the Royal Society. In addition, eleven members of the staff of the Department of Scientific and Industrial Research are fellows of the Royal Society. Eight fellows or university professors are retained as consultants, and fifteen university professors are engaged on extra-mural contracts in their own laboratories.

The ten Research Institutes for which the Department is responsible include the National Physical Laboratory, the Chemical Research Laboratory, and Laboratories or Stations for research on Building, Food Investigation, Fuel, Roads, Forest Products, Water Pollution and Pest Infestation. These, with the Geological Survey of Great Britain, provide facilities of immense importance to our war effort.

The Department renders assistance to the Fighting Services and to practically every Government Department; for example, in home security problems, such as building and shelter construction and bomb disposal, and to the Ministry of Food in food storage, by combating pests and devising economical methods of packing to save space. Geology, among other contributions to our war effort, has informed authorities as to where sand is to be found in urban areas, thus saving transportation and cost.

Similarly the Medical Research Council, with its forty-five committees or sub-committees, its National Institute for Medical Research, its nine smaller research units, and its connexions with research in universities and elsewhere, is doing much to help our war effort. For example, in concert with the Ministry of Health and other Departments concerned, preparations were made before, and expanded during the War, with the view of safeguarding public health against risks arising from war conditions, such as concentrations of transferred populations in some districts, to say nothing of the effects of enemy action. An Emergency Public Health Laboratory Service was established with laboratories all over the country so that any unusual outbreaks of disease might be rapidly identified. Stocks of anti-sera and vaccines were accumulated and distributed throughout the country.

In a speech in this House in July 1939, I mentioned that the application of research in nutrition usually lagged some fifteen years behind discovery. This is no longer true. Under pressure of war conditions results of research are being applied in many directions. The Food Policy Committee of the War Cabinet makes good use of a Scientific Advisory Committee, and the Ministry of Food has a technical advisory staff.

The sphere of the Medical Research Council extends far beyond 'medicine' as this term is generally understood. It is concerned in all problems that affect man's health and efficiency. This enables the Council to assist the Defence Departments in problems relating to personnel and the use of science for increasing the efficiency and well-being of the men who have to operate machines such as aircraft, tanks and so forth. Excellent work of this kind has been done by a Flying Personnel Research Committee set up by the Air Ministry with the co-operation of the Medical Research Council nine months before the War.

The Scientific Advisory Committee has brought this aspect of science to the attention of the other Service Departments. The scope of the Flying Personnel Research Committee has now been expanded to cover naval personnel problems and a Military Personnel Research Committee has also been set up.

The Agricultural Research Council, with its twenty-five standing and technical committees of men of science with special experience of the matters with which they are concerned, with its Field Experimental Station, and with its great influence on the work of the twenty-three existing agricultural research institutes and other agricultural research subsidized by the Government, also makes an important contribution to our war effort.

I come now to the use of science in the military side of the war, where, as already mentioned, the Departments concerned are—the Admiralty; the Ministry of Supply; the Ministry of Aircraft Production, and the Ministry of Home Security.

There is much in common between the methods of research and development of these Departments. Each has a director of research. The Ministry of Supply and the Ministry of Home Security have Central Advisory Committees to assist the directors in planning and carrying out the programme of work. The three Defence Departments are represented on them and the Committees include unofficial as well as official experts. The Ministry of Aircraft Production has an Aeronautical Research Committee, the successor of the Advisory Committee on Aeronautics established in 1909.

The First Lord of the Admiralty recently announced in another place that, in order to strengthen still further the co-operation between the Admiralty Research Department, outside scientific workers, and the Navy itself, the Board has decided to set up a Scientific Advisory Panel.

These Departments maintain research establishments, more than a score in number, all manned by highly qualified men of science. They work in close co-operation with one another, and one Defence Department will often refer a particular problem to an establishment maintained by another which has better facilities for the job. Each Department has frequent resort to the Department of Scientific and Industrial Research and the Medical Research Council, as well as to universities or other research institutes, or the research laboratories of producing firms. There is an increasing tendency to bring the large producing firms into co-operation at the earliest possible stage so that full advantage can be taken of their knowledge and experience.

I must also mention among Service research activities the Ordnance Board, which now acts under the Ministry of Supply. It is an interservice body with executive functions as to trials and calculations concerning fire-arms, their equipment, ammunition and armour. The Board derives originally from the Committee of Field Officers and Artillery under the ægis of the Board of Ordnance, 1518. Its standing members are officers of the three Services, and distinguished men of science are appointed from time to time as associate members.

Civil Departments may be divided for our purposes into those responsible for research establishments or for experiments or tests, and those which are not. Those Civil Departments which have no research establishments of their own usually have scientific committees, and both categories make wide use of the facilities of the Department of Scientific and Industrial Research, the Medical Research Council and/or the Agricultural Research Council.

The main conclusions of the Scientific Advisory Committee from its survey are that the scientific activities of the Government are far more extensive and far more effective than is commonly realized, and that much of the criticism is due to lack of knowledge of the facts. For example, one criticism is that the Government has failed to make effective use of the services of outside men of science. The Committee does not think this criticism justified. The names of nearly three hundred senior men of science associated in scientific work on behalf of the Government have come to its notice. This figure does not include the large numbers of younger men of science engaged continuously on war work in the numerous research establishments maintained by the Government, or in the Services.

It would be too much to claim that the fullest use is being made of every senior scientific worker, but in the more important fields the majority of those especially well fitted to assist our war effort have been given an opportunity to do so. In some fields, however, opportunities may not yet have appeared, and the Committee reports that there has been a feeling of frustration among individuals. In the case of junior scientific workers the demand in different fields of science varies and fluctuates so widely that it is impossible, except very gradually, to absorb in work of national importance all those who are anxious to employ their special knowledge in some form of war activity. Some help, however, is afforded by training schemes whereby men of science trained in one subject, where opportunities for war service are few, can be given rapid training in an allied science.

Having recorded general satisfaction with the range and effectiveness of the Government's scientific activities, the Committee comments that some of the existing forms of organization have proved more effective than others. It directs attention to the effective and economical methods developed by the Department of Scientific and Industrial Research and the Medical Research Council, the success of which it believes is largely due to the fact that they have been allowed full scientific freedom and complete control over the funds at their disposal.

The Agricultural Research Council, as at present organized, has not the same freedom of initiative and action. Believing the scientific development of agriculture to be of the greatest importance to the country, both during and after the War, the Scientific Advisory Committee has considered how much freedom might be secured, and the Council's activities thus made more effective. In consultation with the Minister of Agriculture and Fisheries and the Secretary of State for Scotland, the Committee has drawn up proposals for strengthening fundamental research and ensuring a more ready application of promising scientific discoveries to agricultural practice (see p. 447 of this issue).

So far as the scientific activities of the Defence Services are concerned, the points to which the Committee attaches the greatest importance are the following :

(1) Provision in the organization of departmental scientific staffs for regular consultation

with a strong advisory council or committee which includes outside scientific experts.

(2) The utmost possible use of the facilities of the Department of Scientific and Industrial Research and the Medical Research Council. This is already in operation and is likely to be extended.

(3) A much wider and more intensive study of those problems connected with early and adequate provision for the efficiency of personnel in the design of new instruments of war.

(4) The close co-operation at every stage of research, development and production between the operational and scientific staffs.

I come now to one or two other matters that have engaged the attention of the Scientific Advisory Committee.

The Committee has suggested the names of men of science for particular tasks or to assist in specific investigations to a number of Government Departments, as well as to the British Council. In this connexion I must mention the invaluable work of the Central Register of the Ministry of Labour and National Service, for the utilization in Government Departments and elsewhere of persons with scientific, technical, professional and higher administrative qualifications. With the aid of the Government Departments concerned, and of various outside organizations including the Royal Society, and of a very strong advisory council, the register is very comprehensive.

The question of enlisting scientific researchers of other countries and refugee aliens has been raised. The Scientific Advisory Committee has given a good deal of attention to this question. It presents obvious difficulties. If, as I have said, we have not absorbed into the Government war effort all our own men of science, we cannot absorb unlimited numbers of refugee men of science. In addition, much of the research work is so secret that precautions have to be taken. Nevertheless, a number of refugee specialists are employed in research laboratories, mainly on the medical side so far as the Government is concerned, but also in industry.

Scientific co-operation with the Dominions, India and the Colonies is satisfactorily provided for. Canada, of course, occupies a position of special importance, and her collaboration in the scientific field is proving of the greatest value. There is also in Canada scope for close co-operation in scientific matters with the United States. Prof. R. H. Fowler has been in Canada for some eight months, and is now being relieved by Sir Lawrence Bragg—a colleague of equal distinction.

The Committee has also taken a deep interest in the question of co-operation in scientific matters with the United States. At an early meeting it discussed the matter with Prof. John Fulton of Yale University, who was on a visit to Great Britain on behalf of the U.S. National Research Council. A member of the Committee, Prof. A. V. Hill, had already been to the United States on a scientific liaison mission, and the Committee had discussions both with him and with Sir Henry Tizard, on his return from a similar mission.

After consideration of the Committee's proposals, and after consultations with the proper authorities in the United States, a comprehensive scheme has been put in operation.

His Majesty's Government has elected and sent Dr. C. G. Darwin, the director of the National Physical Laboratory, as director of a Central Scientific Office working under the direction of the British Supply Council in North America to collaborate with United States research bodies, to act as a channel for exchange with the appropriate United States authorities of technical and scientific information, and generally to co-ordinate scientific and technical inquiries to and from the United States authorities, except on those Service questions that are dealt with through the Service attachés. The scientific mission to Canada is closely linked with this system so as to ensure a complete interchange of scientific and technical information between the three countries.

At the same time President Roosevelt has sent to Great Britain Dr. J. B. Conant, president of Harvard University, to establish a corresponding mission in this country, and Dr. Conant and some of his colleagues have attended meetings of the Committee. This mission has received a very warm welcome, and arrangements have been made to facilitate its work. Its permanent secretary, Dr Hovde, knows his way well here, for, as a Rhodes Scholar, he spent some years at Oxford. Accredited American men of science have already arrived in Great Britain.

The historians of war from the earliest time pay their tributes to the importance of science. The theme of a long chapter by Polybius on Archimedes is that "The genius of one man is more effective than any number whatsoever". In these days no one man, whatever his genius, can cover more than a fraction of the immense field of science in war, of which I have only been able to give the faintest impression in the time at my disposal. We require thousands of scientific workers.

We are engaged in a death struggle with an enemy who boasts, with justification, of his achievements in the field of science. Our men of science are at least as good as his, and with the aid of the scientific resources of the Empire, and especially of the Unites States, we are building a scientific equipment which is destined to play an ever-increasing part in our war effort and in the period of reconstruction that must come thereafter.

MALARIA IN WAR*

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THROUGHOUT the centuries of European history, from causes that are still subject to dispute, malaria has ebbed and flowed like a fatal tide[1]. During the nineteenth century the disease was in retreat and in 1914 seemed to be hanging on in only a few localities, mostly in the south-east corner. The War of 1914–18 changed all that. With the massing of troops unaccustomed to infection in malarious regions, malaria became rife among the combatant forces. With the return of these to their homes, and the interchanges of peoples which took place after the War, the disease revived among the civil population in all sorts of unexpected places: in the eastern half of England, the north coast of Germany, parts of Italy long free from malaria, up in the arctic at Archangel; while a terrible epidemic decimated vast areas of Russia.

That malaria would be important to the armies in Europe and elsewhere was foreseen by Laveran, Ross, Nocht, and a few other malariologists; but their warnings were unheeded. How important it proved may be judged from a few figures. In East Africa the average strength of Allied troops was about 50,000. Admissions for malaria in 1916 and 1917 have been estimated at 120,000. In Macedonia in 1916 the French could put into the field only 20,000 men out of a force at least six times this strength. On the same front the British had 30,000 men down with malaria in 1916, 70,000 in 1917. In 1918 more than two million service days were lost on account of malaria.

It is not my purpose, however, to review the whole subject of malaria in war (see Christophers[2]), but, as part of a discussion on the relation between pure and applied biology, to use the subject of malaria as a text from which to illustrate the ways in which pure biological research can help the practical man, and the almost greater frequency with which empirical results provide the starting point for fundamental work.

Let us first summarize the theories of malaria transmission as they are accepted to-day. Malaria is caused by Plasmodium, of which there are three or four species producing in man clinically different varieties of the disease. The sexual forms of the parasite mature and conjugate in the stomach of the mosquito, giving rise to numerous 'sporozoites' which invade the salivary glands and are injected into man when the mosquito feeds. This cycle takes place only in Anopheles. All the members of this genus, which contains some 150 species, are therefore potential carriers of malaria. But in fact relatively few of these species are important—indeed only a proportion of those which breed near human habitations and feed readily on man. In regions of endemic malaria, the local population, while harbouring plenty of malaria parasites, acquires a certain tolerance to the disease (the existence of a true immunity is a much debated question). Such people are the source of the infection which wreaks such havoc among unseasoned troops quartered in their midst.

To consider now the carriers of malaria in the areas of present or prospective hostilities. The chief carrier of malaria in Europe is *A. maculipennis*; a species which breeds in swamps and grassy pools and slowly flowing rivers. It is the species responsible in the Roman Campagna, and many other coastal regions of Italy, Sicily, and Sardinia; the carrier in the notorious Struma Valley in Macedonia, the low-lying parts of Albania and Greece, the coasts of the Black Sea.

Before the War of 1914–18, malaria in Europe was thought always to be associated with low-lying country of this type. It came as a complete surprise to find that malaria was often most intense in mountainous regions. The Germans discovered this in the Taurus of Anatolia, the Italians in southern Italy, the Allies in Palestine. In the eastern Mediterranean rain falls only in the winter. In the spring the streams from the mountains are raging torrents unsuited to mosquito larvæ; but as the summer advances these streams are reduced to broken pools or trickles among stones and provide the breeding places of *A. superpictus*, a species rendered all the more dangerous because during the summer the people concentrate around the few remaining sources of water.

Egypt has commonly been regarded as comparatively free from malaria—because it is not conspicuous in the large towns and military cantonments. But it has recently been realized that there is much malaria, carried probably by *A. pharoensis*, among the rice cultivators of the delta region.

Moving westward into the dry regions of North Africa one would expect malaria to be absent; and that is true enough of the open desert and of the coastal zone of Cyrenaica. But it is not true of the oases. Jarabub and the other oases of the western desert, Kufra and other oases of Fezzan are all intensely malarious. The carrier species is not fully proved but is probably *A. multicolor*, a mosquito that thrives in brackish or highly saline water.

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* A paper forming part of a discussion on the "Relation between Pure and Applied Biology" held by the Association of Applied Biologists and the Society of Experimental Biology at the London School of Hygiene and Tropical Medicine on March 28, 1941.

In the coastal belt of Tripolitania the situation is different. Here are streams running into the sea. These have been blocked by settlers to assist in irrigation. Swampy breeding places for *A. maculipennis* have thus been created, and recent years have seen a great increase in malaria.

In Africa south of the Sahara there are some thirty species of Anopheles but only two are really important. *A. gambiæ* is a ubiquitous species that breeds in rainwater puddles, borrow pits, river pools or quiet backwaters—any water freely exposed to sunlight. In dry regions like Somaliland its prevalence is related to local rainfall. It is the most dangerous Anopheline in the world—its introduction in 1932 from Dakar to Brazil is one of the major health disasters of recent times. It constitutes a threat to the southern parts of the United States, and has caused America to invoke the principle of 'hemisphere defence'. *A. funestus*, the other dangerous African species, is confined to the grassy edges of slowly flowing streams. Such waters are often perennial, so that this mosquito may keep malaria smouldering in a locality until local conditions of rainfall and temperature favour *A. gambiæ* and initiate an epidemic.

That is an over-simplified account of malaria transmission; and particularly so in regard to *A. maculipennis*. For the local abundance of this species bears no relation to the incidence of malaria in Europe. The current explanation of this phenomenon of 'anophelism without malaria' must, in the interests of brevity, be set forth dogmatically[1]. It is that the species *A. maculipennis* is made up of a number of biological races or varieties which differ in their habits and so in their capacity to convey malaria. Morphological differences between these races were at first sought in vain. Systematic entomology, which is often twitted for excessive zeal in subdividing species, proved too superficial for the task. Later such differences were found in the structure and pattern of the eggs. To take a few examples: race *messeæ* with richly patterned eggs and race *typicus* the eggs of which have two bars on a white field, breed in fresh inland waters; they feed almost exclusively on cattle and the chances of their taking the necessary two meals from man at the appropriate intervals are so remote that, with few exceptions, areas where these are the prevalent races are free from malaria. Race *labranchiæ*, with small egg floats and a more uniform pattern, is a brackish water breeder of the western Mediterranean (Italy, Sicily, North Africa). It is far more prone to bite man, and its prevalence is always associated with malaria. Race *elutus*, with no egg floats or pattern, is a brackish water breeder of the Balkans and the Near East. Precipitin tests on the blood in wild caught females have shown a preference for human blood; and wherever this race occurs it is a dangerous carrier. Race *atroparvus* is more puzzling. Its chief area of distribution is the Atlantic seaboard of Europe. In egg type and breeding habits it is allied to *labranchiæ*, but whereas in some localities it attacks man and conveys malaria, in others it seems to be diverted to cattle, and malaria is absent. Perhaps there are differences in the housing of man or animals which will account for this; perhaps there is not one *atroparvus* race but several.

In *atroparvus* regions (around Amsterdam for example) malaria is often a house disease. Instead of going into complete hibernation in the winter (as does *messeæ*, for example) *atroparvus* females will continue feeding and so transmitting malaria to the household. But they fail to develop their ovaries, so that they have no call to leave their resting places and fly afield. Here is an attractive problem, presumably of internal secretion[3], directly connected with the epidemiology of malaria.

What is the zoological status of these mosquito races? Here is a field crying out to be worked by geneticists; particularly geneticists prepared to study the genetics of *behaviour*—for it is the natural history and behaviour of these insects which are important from the malariologist's point of view. A little has been done by the malariologists themselves. Only the *atroparvus* male has so far been persuaded to mate in small cages. Crossed with females of the other races, varying degrees of infertility are revealed, lethality supervening at varying points. With *messeæ* most of the eggs are sterile; with *elutus* the larvæ die; with *typicus* sterile adults of both sexes result; with *labranchiæ* all the resulting females are normal but only a part of the males.

That being the malaria situation, what is the Army doing about it? The general plan (Perry, Manifold, *et al.*, see Christophers[2]) is to establish mobile malaria laboratories. These are commanded by officers with wide experience of malaria in the tropics; their commissioned staff includes malariologists and entomologists; the senior non-commissioned officers will be young graduates in biology or senior laboratory assistants. The function of these units will presumably be to instruct the field hygiene sections in general anti-malarial work; to provide all the necessary local information regarding the incidence of malaria in the local population, and the breeding places, habits and infectivity of the dangerous species;

and to advise on specific measures of prevention.

As an organization this seems well conceived. What it will achieve in practice must depend, as in all human enterprises, upon the abilities of the people doing the work. For there is no rule of thumb in malaria control; each problem is a local problem which must be approached with an open mind. It is where the malariologist has applied blindly, in a new locality, methods which he has found successful elsewhere, that the disasters have occurred which have brought the subject into disrepute.

The methods of malaria prevention still call for investigation. Of all the single measures, sleeping under a mosquito net is perhaps the most valuable. That should be practicable in base camps; but is it possible to devise a bivouac net for use by troops in the open and to persuade them to use it (see Manifold, *loc. cit.*[2]) ?

In the past, little value has been attached to the destruction of adult mosquitoes; but where semi-hibernating *atroparvus* are the cause of malaria this is a most important measure. Under war conditions there may be times when it is the only practicable measure. It involves the whole subject of insecticidal sprays and the methods for dispersing them.

The abolition of breeding places is often an engineering problem of a special kind. The engineer must turn malariologist or vice versa; or the two must co-operate. That is a vast field beyond our scope. One form of engineering control consists in connecting the breeding places with the sea. What factors—water movement, predators, salinity—are here concerned would repay investigation.

Increasing use has been made recently of 'flushing' to control stream breeding mosquito larvæ[4]. Siphons are built into the stream which periodically release a large volume of water. It is believed that larvæ migrating to the margins of the stream are stranded as the flow subsides, but the question merits study.

The classical method of killing mosquito larvæ is by applying oil to the surface of the water. This does not, as is popularly supposed, suffocate the larvæ by preventing their breathing at the water surface. A little of the oil enters the tracheal system of the larva and the oil contains poisons which affect presumably the nervous system. A vast amount of empirical information exists on the preparation and application of oil mixtures, but exact knowledge is scanty. We know almost nothing about the toxic constituents of the oils used.

Oil is usually applied as a spray to form a layer 15–20 μ thick. Equal in importance with toxicity is the ability of the oil to form a stable film of this thickness on the water surface. As a result of an investigation financed by a group of oil companies and carried out at the London School of Hygiene and Tropical Medicine by D. R. P. Murray[5], some light has been thrown on this problem. If an oil contains polar substances such as naphthenic acid or long-chain fatty acids, with a strong tendency to form mono-molecular films on the water, these may spread out ahead of the oil, occupy the water surface, and force the main body of oil into lenses or droplets. Indeed, it has been observed in practice in Malaya that if the coolies waded in the water, an oil which previously spread might be prevented from doing so by oil films coming from their bodies[6]. Such resistance to spreading, or general instability in the oil film, may, however, be overcome by the presence in the oil of 'spreaders'. These are of unknown composition but include 'cracked spirit gum' (derived from polymerization of olefinic hydrocarbons), certain resins, and some constituents of petroleum residues, particularly the undistilled residues of aromatic concentrates. The efficiency of such 'spreaders' in a given oil may be gauged by the direct measurement of their spreading power against surface contamination in the Adam-Langmuir surface pressure trough.

The difficulties of this subject of oils are made greater by the fact that the experimental materials are largely of unknown composition. Mixtures on the market with the same names have often been produced not only from different oil wells but also by different processes. It is clear, however, that a physico-chemical specification for an anti-malarial oil is urgently required. Provisionally we carry out three rough empirical tests: the oil should have a greater spreading pressure than that of castor oil; it should form a fairly complete stable film when sprayed on water in the customary amounts; and Anopheles larvæ below such a film at 24° C. should all be dead in two or three hours.

With some types of water, notably where much vegetation is present, 'dusting' is preferred to oiling. This consists in blowing over the water a cloud containing one or two parts per cent of Paris Green in a vehicle of dry dust. Anopheles larvæ feed at the water surface and are poisoned by the floating particles. Apart from some information about the size of particle ingested by the larvæ, knowledge of this subject is at the empirical stage.

The last method of control I intend to mention (there are many more) is known as 'shading'. This has been developed principally and with great success by Ramsay[7] in Assam and northern Bengal against *A. minimus*, a species closely allied to *funestus*, and which likewise breeds in grassy edged streams. It has been found that if suitable bushes are planted along these streams so that they are densely shaded, *A. minimus* disappears. But the cause of its disappearance has been a matter for speculation. Does the female avoid shaded waters in laying her eggs ; or is the shaded water unfavourable for the development of larvæ ?

During the last three years R. C. Muirhead Thomson[8], supported by the Royal Society and the London School of Hygiene and Tropical Medicine, has been working on this problem in the tea gardens of Assam. Briefly, he has shown that although the female *A. minimus* lays her eggs during the night she prefers to lay them in the shade. At a light intensity one quarter of starlight she will still show a preference for deeper shade ; below 0·000008 ft. candle, about one tenth of starlight, she becomes indifferent. Yet egg collections in the field show that she does not lay in the shaded streams. Thomson has proved that this is because she will not lay in moving water. Under laboratory conditions she refuses to lay in water flowing at a rate of 0·05 ft. per sec. Normally she finds both shade and still water among the grass at the margins of the streams. All this vegetation is eliminated by shading.

Shade also exerts an effect upon the larva. Contrary to general belief these stream-breeding larvæ have very weak powers of resistance to flowing water. *A. minimus* larvæ cannot remain anchored if the rate of flow exceeds 0·29 ft. per sec. They normally find the still water necessary to their security in the grassy margins. They are kept there, not by an avoidance of moving water but by a reaction to light and shade which is enhanced by flowing water.

In this reaction to light are several elements : (1) a photokinesis or increased activity in bright light. This may be inhibited by thigmotaxis if the larva is anchored to some object. (2) An undirected avoiding reaction on passing from shade to light. (3) A directed reaction or phototaxis towards an area of shade. Under experimental conditions the larva can be made a victim to these responses, and by shading the middle of a stream can be caused to leave the margin where it is safely anchored and swim to the middle, where it is swept away by the current.

This work illustrates well enough how right the malariologist may be in his methods and how completely in the dark as to their mode of action. He has no time and often receives no encouragement to probe deeply into such matters. Here lies a vast and profitable field awaiting the attention of research workers informed on modern biology and unhampered by the need of producing immediate practical results.

[1] Hackett, L. W., "Malaria in Europe" (Oxford, 1937).
[2] Christophers, S. R., *Trans. Roy. Soc. Trop. Med. Hyg.*, **33**, 277–304 (1939).
[3] Wigglesworth, V. B., NATURE, **136**, 338 (1935).
[4] Macdonald, G., *J. Malar. Inst. India*, **2**, 63 (1939).
[5] Murray, D. R. P., *Bull. Ent. Res.*, **27**, 287 (1936) ; **29**, 11 (1939) ; **30**, 211 (1939).
[6] Hacker, H. P., F.M.S. Malaria Bureau Reports, 3 (1925).
[7] Ramsay, G. C., *Trans. Roy. Soc. Trop. Med. Hyg.*, **23**, 511 (1930).
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APPLICATION OF PLANT GROWTH SUBSTANCES IN PRACTICE*

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In order to focus attention on certain aspects of the application of biological science to those industries concerned with the growing of plants, it is proposed to consider briefly one example, perhaps already familiar to some readers of NATURE.

THE FUNDAMENTAL RESEARCH

For very many years it was a commonplace observation that the stems of most plants usually grew towards light, yet the elucidation of the mechanism involved took place comparatively recently. The physiological investigations of tropisms, as such growth movements are called, were carried out in university laboratories at Copenhagen by Boysen Jensen and at Utrecht by F. A. F. C. Went and his associated workers ; during the years 1910–27 they progressed steadily yet bore no obvious signs of having any practical application.

In 1927 Went[1] reported the isolation from, and reintroduction to, the tissues of seedling oats of one (or more) active hormone capable of controlling the rate of growth in length of the tissues of the young shoot. A technique was gradually perfected whereby minute traces of the active substance could be estimated in relative but quantitative terms, or 'oat-units.' Some six years later a team of biochemists led by Kogl[2] determined the chemical composition of auxin *a* and its related form *b*, as these hormones were named ; they proved to have an elaborate structure (*a* $C_{18}H_{32}O_5$). Whilst searching for a ready source of these compounds Kogl tested urine; by good fortune he found a third substance with activity of a similar high order of magnitude, 25 million oat-units per milligram, but of much simpler constitution.

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* Substance of the second paper contributed to the discussion held at a joint meeting of the Association of Applied Biologists and the Society for Experimental Biology held on March 28

This was quickly recognized as indolyl-3-acetic acid, a compound soon readily available for numerous investigators to apply to the tissues of many plants in various ways[3].

SOME OF THE PLANT RESPONSES

Small quantities in lanolin, at 0·1 per cent, applied to the stems of quickly growing plants such as tomatoes, caused twisting and bending of the stems and petioles and drooping of the leaves. After 24–48 hours, rapid cell division had begun in the region of the cambium and inner phloem and elsewhere. After a week or 10 days the division of the cells resulted in root formation, and in moist conditions these roots emerged to the air through the outer tissues. This was a response of high potential practical value and at once attracted the attention of applied biologists familiar with the problems of vegetative propagation[4].

Another response observed was the retardation of the development of buds on the stems.

CHEMICAL EXPANSION

Using other plant tissues, sweet-pea stems, as testing materials, Zimmerman, Wilcoxon and Hitchcock[5] added to the list of active substances α- and β-naphthylacetic acids, indolylbutyric acid and other substances and later (1936[6]), the esters of these and other related acids which, like the metallic salts, also proved active. As numerous additions were made it became increasingly difficult to correlate chemical configuration with physiological activity. Linser[7] in 1938, cited more than fifty active substances; among more recently added compounds may be mentioned naphthylacetamide and thionaphthylacetamide (Stoutmeyer[8]) and naphthylideneacetic acid (Tincker[9]). Stereo-isomerides may differ in their activity as shown by Zimmerman[10] with the cinnamic acids and by Tincker with the naphthylideneacetic acids. Although indolylacetic acid is closely related to tryptophan, which is a possible precursor in plant tissues when parallel deamination is carried out with tyrosine and phenylalanine and histidine, the activity of the acids so derived is of a low order.

APPLICATION IN PROPAGATION

The earlier attempts were made using lanolin pastes applied directly to the stem, or after glycerine had been rubbed into the tissues, or into longitudinal incisions made in the stems of woody cuttings. Laibach[11] was able to accelerate the rooting of cuttings of the apple stock Doucin XI, and of *Prunus mahaleb* and to increase the number rooted of *Parrotia persica*. Among early successes may be mentioned Cooper's[12] experiments with lemons and Zimmerman's[13] with American holly treated with dilute solutions. In Great Britain from early 1936 onwards, extensive tests of naphthylacetic, indolylbutyric and indolyl acetic acids have been made with a wide range of plants at Wisley, and at Kew by Templeman and Metcalfe[14], at East Malling by Pearse[15] and Garner, also at Reading by Stoughton and Plant[16], and elsewhere. In 1939 an index was prepared by Pearse[17] showing the practical results with these substances; a thousand entries were obtained. Among economic plants, fruit stocks, bush fruits, coffee, citrus and vines occur in this list. Thus after three or four years of applied work it may be justly claimed that the use of these substances was established.

Among plants well known to be difficult to propagate vegetatively there is a gradually decreasing number of unresponsive species. Thimann and Lisle[18] have reported success with *Tsuga canadensis*, *Picea pungens*, *P. abies Pinus insignis*, has responded at Wisley[22]. Grace in Canada tested the Norway spruce[19]. Afanasier tested Betula, Acer and Populus[20]. Such results are directly applicable to forestry, as are those of Plank[21] with pine seedlings. To-day these results have added significance if our forests are to be maintained. Chrysanthemums are readily propagated, but the increased number of roots and larger root systems obtained by treatment is considered, by certain large firms, to be justified. The tests were made on a very large scale involving several hundred thousand plants. Thus was the 'mass production' stage reached.

The treatment given to cuttings varied in concentration with the nature of the tissues—herbaceous or woody. The response obtained varied according to the season of application—generally leafy cuttings responded better than hard wood. Over such details, perhaps of little interest to the experimental biologist, must time be spent by some biologist, for sound advisory services afford perhaps the best of all introductions to an industry in which skilled operators are rightly both critical and proud of their own achievements. Although greatly facilitating propagation, the use of these compounds does not replace technical skill.

Following the work of Bonner[23], Green[24], and Robbins[25], who found that vitamin B_1 (aneurin or thiamin chloride) was necessary for the continued growth of roots, *in vitro*, other investigators (Went, Bonner and Warner[26]) reported that traces of B_1 accelerated the rate of root growth. When added to the growth substances and applied to cuttings at Wisley[22] the results proved very uncertain (certainly aneurin did not alone induce root formation), and only in a very few cases did it cause more rapid growth of stems or roots. More encouraging results were seen at Leverkusen in 1938.

ASPECTS OF MARKETING

By the aid of various solvents, proved not toxic to the plants at the ultimate dilution employed, solutions became available. The results obtained quickly attracted the keen attention of enterprising chemical firms. In the United States indolylbutyric acid was marketed 'under licence', or some measure of supervision of the research institute that proved its value. Other firms, some perhaps less scrupulous, copied this venture. In Great Britain one firm quickly marketed a readily available but relatively ineffective compound. Its sales were on a small scale. Naphthylacetic acid was later marketed in solution but was not sold pure ; to it was added a mixture of carbohydrates, contrary to some advice tendered at the time. Although effective as a rooting stimulant this solution was promptly reported to become 'cloudy' and to encourage bacterial and fungal decay in some cuttings. Another firm was therefore approached and indolylbutyric acid was consequently marketed ; it also appeared under a trade name but the contents were declared. A further firm marketed the solutions under their chemical names giving full details of the contents.

Powders are now available[27] in which the active substance is diluted with talc, fuller's earth, or similar inert substance. Although speedier to apply—the wet cuttings are quickly dipped into the powder and sufficient adheres—they are not quite so effective as solutions. They may be purchased in different concentrations. Another form of preparation is in pellets, made to dissolve in readily measureable units of water, thereby solving the problems of dilution for amateurs. Other devices for obtaining correct dilution have been marketed, including small measuring tubes and dropper measures. Instructions are usually provided.

The advertisements of our reputable firms have, on the whole, adhered strictly to the facts ; the same cannot be said of all firms in all countries where "miracle rooting solutions" are advertised.

The dissemination of knowledge of these substances and their proper use has been carried out by articles in popular papers, in the gardening Press, by broadcasting, by exhibits at shows, by advisory letters, lectures to trade guilds, and other means, including advertisements.

APPLICATION OF GROWTH SUBSTANCES TO ENTIRE GROWING PLANTS

Grace[28] reported that seedlings watered with indolylacetic or naphthylacetic acid at certain concentrations between 10^{-7} and 10^{-8}grew more vigorously than did controls or seedlings receiving heavier applications, which damaged the tissues. The plants tested were Nasturtium, Salvia and tomato. More stimulation occurred in sand than soil. Similarly Amlong and Naundorf[30] reported stimulation, but Templeman[31] found that indolylacetic, naphthylacetic and ascorbic acid gave no significant increase in dry weight when applied as a spray or by watering the soil with solutions.

In a series of experiments made at Wisley[3] with dilutions varying from 0 through 10^{-7} to 0^{-1} indolylacetic acid, naphthylacetic, tetrahydronaphthylideneacetic, glyoxaleneacetic and other compounds proved ineffective, for no stimulation was observed. The plants used were annuals. Templeman and Marmory[32] obtained generally similar negative results with lettuce, with mustard and tomato.

Grace[33] reported stimulation with indolylacetic acid and naphthylacetic acid at two parts per million seed weight, when dusts were applied to grain at the rate of ½ ounce per bushel. Later Grace found that the application of the growth substances to cereal seeds more than overcame the ill effects of grain treatment with formaldehyde.

In a field trial McRoster, Hopkins and Grace[34] again obtained increases in yield, 13 per cent grain and 20 per cent straw, but the results were variable. The growth substance was applied with a proprietary mercury fungicide. Croxall and Ogilvie[35] obtained with peas, in sterile soil, an increase in dry weight by treatment with various seed dressings to which growth substances were added. They also found that the check to growth caused by mercurial dressings was largely or entirely overcome by the addition of naphthylacetic, indolylbutyric and naphthylideneacetic acids. The crop yields were greatly increased—up to 80 per cent increases were found.

A somewhat similar experiment at Wisley gave negative results at early stages of growth. No stimulation occurred with other seeds, including lilies. In a recent private communication, Ogilvie states that with other plants, lettuce and beet, he has not obtained such stimulation as he observed with peas. Similarly Templeman and Marmory[32] found that with oats, wheat, barley and sugar beet, in sand and soil tests, in pot and plot experiments, seed dressings containing naphthylacetic or indolylacetic acid in talc did not stimulate growth or dry-matter production.

Only further work can elucidate these apparently contradictory results ; as yet no recommendations can be safely made to practical growers, and thus in three years little advance has been made in this application.

VITAMIN B_1 APPLIED TO THE SOIL

From its structure thiamin chloride does not appear likely to be a stable substance when exposed to bacterial activity in soils. Yet in the popular American Press extravagant claims have been made of the stimulation to growing plants that results from its application to the soil. In July 1940, some three hundred and fifty firms were selling vitamin B_1 under various trade names. The considered report of the Bureau of Plant Industry shows that no reliance can be placed on the results. Hamner[36] in tests made with long- and short-day plants under controlled periods of light obtained no effect by its use at reasonable rates. It proved quite ineffective. In Great Britain the substance can no longer be purchased as a plant stimulant as it is required for addition to bread. In this matter commercial enterprise has outstripped applied science; perhaps stricter control should be exercised to prevent exploitation of the public, more especially when every endeavour is being made by an increasing number of people to grow more food. Firms of established repute are reluctant to market such preparations for such purposes.

OTHER USES

Gardner, Marth and Batjer[37] applied naphthylacetic acid and naphthylacetamide to fruit trees, and by delaying the formation of the abcission layers prevented the early June drop of apples. This work is now being followed up at East Malling. The formation of parthenocarpic fruits induced by spraying with solutions of growth substances awaits wide commercial application, as does the retardation or inhibition of bud development along the lines of Guthrie's[38] work, but fruit bud retardation in relation to sprays is being studied in Great Britain. The effects of these substances observed by Zimmerman[39], on various storage organs of plants, has not as yet been applied on a commercial scale.

GENERAL OBSERVATIONS

The study of only one example does not permit generalizations of much value to be made, but certain observations bearing on the general discussion are perhaps permissible.

(1) The 'long-range' work undertaken with no thought of commercial practice extended over many years in its physiological and biochemical aspects. It led to the isolation of auxin.

(2) A wide "chemical expansion" whereby many substances were proved active followed during the subsequent five years.

(3) The details such as concentration, time of uptake, or points of technique required some three or four seasons for establishment. Thus the actual application of laboratory discovery to an industry based on seasonal procedure takes several years. Possibly in a few cases this period of testing might be materially reduced, but where plants or crop varieties may react differently the period cannot be greatly reduced.

(4) The actual marketing and use of such substances raises questions of control, of proprietary substances, and advisory services.

The business houses accomplish a large part of the necessary publicity but cannot undertake all the necessary advisory duties. It is essential to make the information readily and quickly available.

(5) The immediate necessity is to remove all obstructions in the flow of knowledge at any point from *A* to *Z*; from pure research to industry. 'Bottle necks' may occur at various stages through lack of co-operation by men of science, and more frequently in the lack of dissemination of accurate information.

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MINERAL RESOURCES OF CONTINENTAL EUROPE*

BY DR. W. J. ARKELL

THE BALKANS

The Balkans have for a long time been a region towards which German industrialists, prospectors and geologists have turned acquisitive attention as a source of mineral wealth. The political status of the countries there ranges from some completely subject to the Axis (Rumania, Hungary, and Bulgaria), through a country in process of being freed from Axis control (Albania), and one which has just declared against the Axis (Yugoslavia), to one actively allied for some time past with Great Britain (Greece). Political conditions are as usual so unstable that only a non-political order of treatment can remain valid for any length of time.

Hungary, now in possession of former Rumanian territory, is grouped with the Balkans for convenience.

HUNGARY

Oil. With a production of more than 103,000 tons in 1939 Hungary was nearly self-supporting in oil.

Manganese. By 1938 Hungary was producing her domestic requirements of high-grade manganese ore and exporting quantities to Germany.

Aluminium. Hungary has by far the biggest bauxite deposits in Europe, amounting to at least 40 per cent of the total and perhaps much more. Up to 1937 the production was 25 per cent, second to France (32 per cent). According to some published estimates, the Hungarian total reserve is nearly 500 million tons, which would be by far the largest of any country in the world.

RUMANIA

Oil. With a production of 8¾ million tons of crude oil in 1936, and 6¼ million tons in 1939, after three years of neglect of new drilling, Rumania constitutes the greatest mineral prize in all Europe for the blockaded Axis powers.

Copper was worked extensively by the Germans in the War of 1914–18.

Manganese is produced in many regions. The total reserves are estimated at about 9 million tons of ore with 14–40 per cent manganese.

Chromium. The Germans are reported to have obtained about 40,000 tons of chromium ore during the War of 1914–18 and the total reserves are estimated at 2 million tons.

Molybdenum. Rumania is the second largest producer of molybdenum ores in Europe, coming after Norway, with about 14 per cent of the recent annual production, equivalent to 90 tons of metallic molybdenum. The year 1938 showed a great jump in production which indicated that considerable expansion is possible.

Aluminium. It is estimated that Rumania, even with its new frontiers at the end of 1940, contains 20 million tons of bauxite reserves, as yet scarcely developed.

Pyrites deposits are considerable, amounting to about 10½ million tons.

Mica occurs in fair quantities. The production in 1936 was 66 tons, or second after Sweden, but it has since declined.

BULGARIA

Copper. Bulgaria is estimated to have a reserve of at least half a million tons of probable ore with 4½ per cent copper and more with 2–3 per cent.

Manganese. Germany acquired 30,000 tons a year of good manganese ore from Bulgaria during the War of 1914–18.

Chromium. In recent years there has been a rapidly expanding production of chromite and there are known to be new deposits not yet developed.

YUGOSLAVIA

Yugoslavia is one of the richest of European countries in metals.

Copper. In recent years Yugoslavia has led European countries in the production of copper, with 28·5 per cent of the total in 1937, and the production increased in 1938. The ore body at Bor is the second largest in Europe after that at Outokumpu in Finland.

Zinc and Lead. In 1937 Yugoslavia produced 11 per cent of the European zinc and 26·5 per cent of the lead—a lead production second only to Germany's. The Trepca ore body is the most important source of lead in Europe, with a reserve of nearly 4 million tons estimated to contain 9·5 per cent lead, 5·2 per cent zinc, and some silver.

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* *Continued from* p. 407.

The Misitsa lead mines produce ore with 11 per cent lead and 5 per cent zinc.

Manganese. Germany acquired 48,000 tons a year of high-grade manganese ore from Bosnia in the War of 1914–18. Since then another extensive deposit has been developed.

Chromium. Production has increased steadily from numerous deposits and Yugoslavia already leads in European production. It is believed that prospecting will reveal still further deposits. The 1937 production of nearly 59,000 tons of ore, containing 28,000 tons of chromic oxide, was equivalent to 45 per cent of Germany's imports in the same year.

Aluminium. Yugoslavia contributes 16 per cent of the total European production of bauxite, and her reserves amount to 80 million tons, or 22 per cent of the proved European total.

Magnesium. Large deposits of magnesite have only recently begun to be worked and many more are still untouched. The magnesite is of the highest quality and could sustain large-scale exploitation for at least half a century.

Mercury. Large deposits of cinnabar occur in several parts of Bosnia and Serbia, and there are others in Dalmatia and northern Macedonia. At one time Serbia alone produced an average of nearly 140 tons of mercury a year (about one tenth that of the Spanish output in 1937).

Antimony. There are important deposits in Serbia and smaller ones elsewhere. With a production in 1937 of 4·35 per cent of the total antimony production of Europe, Yugoslavia easily heads the list of producers. But in 1938 the production was nearly doubled, amounting then to 3,370 tons of metal. This amount is nearly five times the production of the whole British Empire and three times that of the United States.

Pyrites occurs in large quantities at Maidanpek and Bor in Serbia, and also in Bosnia (see under copper).

Mica. In Macedonia there is a workable reserve of at least 300,000 tons of sheet mica.

ALBANIA

Oil. With a production of more than 207,000 tons in 1939, Albania has been a precious source of crude oil to Italy and its loss would be serious.

Chromium. Extensive deposits of good quality chrome ore were recently discovered in the neighbourhood of Lake Ochrida.

Pyrites. Large lenses of high-grade pyrites as yet undeveloped, but easily accessible, may contain a reserve of up to 20 million tons, or 2·6 per cent of the European total.

GREECE

Chromium. Greece, with a production of 42 per cent of the European total, is second only to Yugoslavia (56 per cent). The production has been rising rapidly and could doubtless be stimulated considerably. If Germany acquired control of the mines as well as those in Yugoslavia her needs in chromium would be satisfied.

Aluminium. Production of bauxite increased more than tenfold between 1935 and 1937, to 6·5 per cent of the European production. The reserve is about 5 million tons, or only 1·3 per cent of the European total.

Magnesium. Vast quantities of exceptionally pure magnesite occur. In 1937 Greece accounted for 21·3 per cent of the European production, second only to Austria (60 per cent).

Pyrites. There are reserves of at least 5 million tons. Greece is sixth among the producing countries of Europe.

SPAIN

Iron. Although only accounting for 3·7 per cent of the European output in 1938, Spain contains more than 10 per cent of the European reserves of metallic iron. Among them are some of the largest deposits of Bessemer ore in the world, conveniently placed for shipment.

Copper. The huge pyrites and chalcopyrite deposits at the Rio Tinto mines contain 60 per cent of Europe's reserves of metallic copper. The production in 1937 was only 18·5 per cent of the total European production.

Lead. Spain produces 11·4 per cent of the European total of lead, but only 4·6 per cent of the zinc.

Manganese. There are high-grade ores in many provinces, and the production in the past has averaged more than 100,000 tons a year.

Vanadium occurs in small percentages in lead and zinc veins and also in phosphates. Of the latter there is a probable reserve of 200 million tons with 0·25 per cent vanadium—a total of half a million tons of metallic vanadium.

Mercury. The cinnabar deposits of Almaden are the largest and richest in the world. In spite of primitive methods of working, Spain headed the world production until 1937.

Phosphates. The phosphate deposits of Spain are believed to amount to 23 per cent of the European total (in terms of P_2O_5).

Pyrites. Nearly half the world's total reserve of pyrites occurs in Spain, and 63 per cent of the European reserves. Spain leads European production with about 37 per cent, after which comes Norway with 17 per cent.

Potash. Spain possesses 8·6 per cent of the European potash salts, or nearly half those known outside Germany (the only others being in Alsace and to a much smaller extent in Poland). So far her output does not amount to 5 per cent of the total European production.

PORTUGAL

Copper. About 8 per cent of Europe's copper reserve is in Portugal. In 1937 the production was 5,518 tons of metallic copper, or 3·8 per cent of Europe's total.

Tin. Portugal is at present the only country producing anything but negligible quantities of tin. The amount, however, is not very great (maximum 1,435 tons in 1939).

Tungsten. Portugal produces 94 per cent of the tungsten output of Europe. In 1938 the amount was equivalent to 1,660 tons of WO_3. Germany, in the same year, imported ores to the amount of about 9,000 tons of WO_3; but in 1936, when she was not building up stocks for war purposes so actively, her imports of ore amounted to only about 5,800 tons of WO_3. The Portuguese supply is therefore equal to meeting at least 25 per cent of the normal German demand for tungsten.

Titanium. In 1937, 1,433 tons of ilmenite were produced.

Uranium. In 1936 Portugal had the second largest uranium output in the world, after Bohemia, representing 40 per cent of the European production.

Pyrites. Portugal is responsible for about 10 per cent of the European pyrites production; but her reserves are not one twentieth the size of the Spanish.

SWEDEN

Iron. The Swedish iron ores are the richest in Europe. The production is 29 per cent of the European total, in terms of metallic iron, and the reserve is 13 per cent of the total reserve.

Zinc and Lead occur in important quantities. Sweden accounts for 8 per cent of Europe's zinc production.

Tungsten. Sweden is the only other country besides Portugal that produces appreciable quantities of tungsten. In 1938 she produced tungsten ore equivalent to 108 tons of WO_3 and also exported 1,510 tons of ferro-tungsten.

Molybdenum. About 4 per cent of the European output of molybdenum is produced in Sweden; but the amount could be increased.

Vanadium. The Swedish iron ores, like the German, contain small quantities of vanadium, which is recovered during the smelting, both in Sweden and in Germany. The percentage is low; but the aggregate recovery of vanadium is highly important.

Titanium. Most of the Swedish iron ores are more or less titaniferous, like the Norwegian. The Taberg ore body especially contains 4–10 per cent titanium and could yield large quantities of titanium if necessary.

Arsenic. One of the world's largest deposits of arsenic occurs at Boliden mine, worked for gold, silver, copper and sulphur. The arsenic produced as a by-product exceeds the whole world's consumption.

Mica. The small Swedish mica industry heads the European production with 129 tons in 1938 (34·5 per cent).

FINLAND

Copper. Finland has three important copper districts, which together contain 7·5 per cent of the European reserves of metallic copper and account for 8·6 per cent of the production. Outokumpu is the largest known copper ore body in Europe.

Pyrites. The copper ore body of Outokumpu contains a pyrites reserve of probably 20 million tons, which is about the same as the estimated pyrites reserves of Portugal and Albania respectively.

Asbestos. Finland heads the European production of asbestos, with 43·5 per cent of the total. The bulk of the exports usually go to Germany and Sweden, and since the percentage of the European production within Germany and the conquered territories is only 18, this trade is of importance to Germany.

POSSIBILITIES OF THE U.S.S.R.

To what extent can the U.S.S.R. help the continent of Europe to be self-supporting in mineral resources? Many important metals, especially copper, lead, tin, nickel, tungsten, molybdenum and antimony, she imports for her own needs and so competes with Europe. There are, however, a few important commodities of which she has such an abundance that there is a substantial surplus even after her own huge consumption has been met.

Oil. The surplus of production over domestic consumption was 6·5 million tons in 1938 and 7·5 million tons in 1939, and this could be increased by restricting internal consumption. Petrol rationing was introduced in Russia as from January 1, 1941. Russians claim in recent years to have discovered many vast new oilfields containing reserves of more than 6,000 million tons of crude oil, or three times as much as the present proved reserves of the United States and nearly 60 per cent of the world's total reserves. It is still uncertain how far these claims are justified.

Manganese. More than 70 per cent of the world's reserves of manganese ore are in the U.S.S.R., and in 1937 Russian production was 46 per cent of the total world production. It has been stated that under the Russo-German trade agreement of September 1939 the U.S.S.R. guaranteed Germany half a million tons of manganese ore a year, or more than required for the total steel output of Germany, Austria, Czechoslovakia and Poland in the year 1937.

Chromium. In the year 1936 (the latest for which figures are available) the U.S.S.R. had a larger production of chrome ore than any other country in the world, and she exported more than 3,000 tons of chromates.

Magnesium. In the year 1937 the U.S.S.R. produced about 40 per cent of the world's total production of magnesite, far more than any other country. This is of no advantage to Europe, however; since Europe itself has ample deposits and accounted in the same year for 36 per cent of the world's production.

Zirconium. The Kola Peninsula and the Urals contain considerable deposits of zirconium, which formerly were worked successfully and could be reopened in case of need.

Platinum is produced extensively and is a metal entirely lacking in Europe.

Fertilizers. Russians have claimed recently to have proved vast reserves of phosphates and potash in the U.S.S.R., by far exceeding those in all the rest of the world. Central Europe already has a glut of potash salts, but urgently requires phosphates. Russia exported apatite, phosphate rock and superphosphate to the extent of more than half a million tons annually in 1936 and 1937, while in the first half of 1938 the figure rose to a rate equivalent to more than a million tons a year.

Asbestos. In 1936 the U.S.S.R. produced 24·5 per cent of the world output of asbestos, and exported more than 25,000 tons. The exports increased to more than 27,000 tons in 1937.

Graphite. Although in 1935 the U.S.S.R. produced about 38 per cent of the world output of graphite, she exported none in 1937 or 1938.

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NEWS AND VIEWS

Yugoslavia

GERMANY'S attempt to fasten a strangle-hold on Yugoslavia by 'diplomatic means' may prove to have been an even greater blunder than the miscalculation of Mussolini's threat to Greece. The Axis powers, like Germany in the War of 1914–18, have shown themselves singularly inept in estimating the force of the spirit of resistance in a free people prepared to endure suffering even to martyrdom in defence of a way of life and a tradition which embody their highest ideals. No doubt the German leaders have been confirmed by their experiences of recent years in a cynical realism which backs mechanized forces against an idealism with little to rely upon beyond the strength of its right arm and the justice of its cause. Yugoslavia, however, stands in a category different from those nations until lately free, which have succumbed to the traitor within their gates. By the bloodless revolution of March 26–27, Yugoslavia, to quote Mr. Churchill, "found her soul". Her three peoples stand united in their resistance to aggression. Nor must it be forgotten that each one of them has a long and honourable tradition in the cause of freedom.

When the German Führer sought to bring Yugoslavia into subjection as Rumania and Bulgaria had been brought into subjection, had he forgotten how the reorganized Serbian army in the War of 1914–18, after three years of exile and eclipse, showed themselves worthy sons of the heroes of the field of Kossovo, how they were the first of the Allied troops to break through the ring of the Central Powers, and how in a drive, which in the difficult conditions of the terrain was little if at all less spectacular than some of the recent advances of British troops in Africa, expelled the enemy from their country within a few weeks? Now Yugoslavia has been forced to take up arms, her army, composed of men who are among the bravest and strongest fighters in the world's armed forces, aided by the difficulties of a country which offers little facility for the technique of mechanized warfare, may well prove, as it did in the last War, the pivot upon which will turn the struggle on behalf of freedom. As in the War of 1914–18 the health of the armed forces will need special attention. During 1916–17, malaria claimed a deadly toll. In fact, medical grounds might well prove ultimately as important as strategic (see page 436 of this issue).

The independence of Serbia from Turkey was established by the Treaty of Berlin in 1878. After the revolution in Austria-Hungary, Slovenia, Croatia, Dalmatia and Bosnia declared their independence, and their union with Serbia, together with that of Montenegro, which had been voted on November 13, 1918, was proclaimed on December 1, 1918, when the official name of the State was announced as being the Triune Kingdom of the Serbs, Croats and Slovenes. Further modifications of boundaries followed, and on October 3, 1929, the name of the State was changed to the Kingdom of Yugoslavia. The estimated population at the beginning of 1936 was nearly fifteen millions. All religions recognized by law enjoy the same rights, and comprise the following: Serbian Orthodox, 48·7 per cent; Roman Catholic, 37·45 per cent; Greek Catholic, 0·32 per cent; Protestant, 1·66 per cent; Moslem, 11·2 per cent; Jews, 0·49 per cent; others, 0·18 per cent. Primary education is free and compulsory. Secondary, technical and agricultural educational facilities are good. There are three universities, namely, the University of Belgrade with about five thousand students, University of Zagreb with about five thousand students, and the University of Lyublyana, founded in 1920.

Agricultural Policy in Great Britain

ON April 3, the House of Commons went into Committee of Supply on a supplementary vote for the Ministry of Agriculture. The Minister (Mr. R. S. Hudson), in his reply to Earl Winterton, pointed out that between 1914 and 1918, before Mr. Lloyd George started his food production campaign, about 32 per cent of the cultivable land of Great Britain was under crops. By the end of 1918 that was raised to 38 per cent. At the beginning of this War, the percentage was only 28, but in the same period it has been increased to 40 per cent. Thus, in the War of 1914–18, 2,300,000 acres were ploughed up, and it is to be expected that by this spring 3,750,000 will be ploughed up. Against this, it must be realized that the population of the United Kingdom has risen since 1917 from 41,000,000 to 47,750,000, while the land available to provide the food has decreased by 2,500,000 acres. Thus, the farming community has made a very remarkable contribution to the British war effort. The farming survey is to be revised and will be of great value for the food production campaign and even more valuable to the post-war agricultural policy.

The Minister of Agriculture is persuaded that the quickest and biggest increase in production can be obtained by increasing the productivity of the existing arable land, improving the existing grassland, and above all by raising the standard of farming. In the last seven months, the various committees have done very nearly as much towards draining land as it took the Italian Government thirteen years to do in reclaiming the Pontine marshes. Many parks, too, have been ploughed up. Golf courses are not so valuable, but where they can make a substantial contribution they will be asked to do so, while those unsuitable for ploughing will be used for grazing sheep.

In regard to research, the Agricultural Research Council is to be granted an increased sum for use at its unfettered discretion for promoting basic or fundamental research (see also p. 434 of this issue of NATURE). Thus it is hoped to use for the advantage of agricultural research the best brains of the scientific world. The Minister proposes to appoint for England and Wales a body which will be directly responsible to him and which will be concerned to devise methods for ensuring that promising results of research are applied as rapidly as possible to the problems of agriculture and incorporated in the everyday practice of the farmer. A similar body is to be appointed for Scotland. The question of the reform of agricultural education is also to be considered.

Science and Democracy

THE American Association for the Advancement of Science recently forwarded to the British Association a resolution adopted by its Council, inviting the collaboration of British men of science with their American colleagues in framing a charter of democracy on scientific principles. The resolution was passed to express whole-hearted support of the rights of free peoples of the world and the desire of scientific men to share in the responsibility of maintaining them at this time of international stress. It was intended as a significant joining of 'hands across the sea' in a common cause and with the hope that the grasp might lead to effective action.

When this expression of unity of feeling and purpose with Great Britain in the present War was communicated to the Council of the British Association, the resolution was referred to the Committee of the Division for the Social and International Relations of Science. It need scarcely be said that the friendly approach from the United States was highly appreciated, and the co-operation suggested was gladly undertaken. The wording of the American resolution invited co-operation "in attempting to formulate, upon scientific principles, an international charter of democracy". It became clear, however, from inquiries that this phrase represented an attitude and a hope, and was not intended to be a precise term of reference for any committee which might be appointed by either of the two Associations to consider the subject. The Committee of the British Association Division therefore decided first to formulate a statement of the democratic fellowship of science, believing that such a charter would include the basic elements of scientific principles of democracy. This charter has been drafted and communicated to the American Association as well as to the Council of the British Association, as a contribution to the co-operative effort of English-speaking scientific communities to promote the advancement of knowledge and action in an international spirit. Whether a charter of the scientific commonwealth can be made the foundation of a world fellowship has yet to be considered.

University of Liverpool: Air Raid Damage

IN a recent raid on Liverpool some of the University buildings suffered damage. One of the engineering laboratories received a direct hit and was practically wrecked. Part of the Medical School was also severely damaged, but the effect here was less direct and the structure is not seriously impaired. Other buildings of the University suffered from blast, many windows, roof-lights, and doors being destroyed. There is, however, no reason to fear that the work of the University will be restricted; the remaining engineering laboratories are adequate to carry on the work of the Faculty with little reduction of efficiency, and repairs are proceeding rapidly on the other laboratories. The amount of the damage is estimated to be about £100,000, so far as it can be ascertained at present. Fortunately, there was only one casualty and that of a minor kind.

Engineers' Achievements under Aerial Bombardment

THE twenty-first annual general meeting of the British Electrical Development Association was held in London on March 21 under the presidency of Lord Lytton. The meeting was preceded by a luncheon at which the Minister of Transport was the guest of honour. In reply to Colonel Moore-Brabazon, Lord Lytton pointed out that, in the last twelve months, the electrical industry has undergone the severest test in its existence. In spite of air attacks, electricity supply has suffered no prolonged interruption, but few of the general public have any idea what this has meant. Too many are apt to take it for granted, like all the other machinery of civilized life to which they are accustomed. In the first place, this 'maintained supply' was due to improvements in the distributing system which were carried out in the years before the War. It would not have been possible at the time of the War of 1914–18. The national pool of the whole industry, the interconnexion of the mains of different supply authorities and the amalgamation of different competing authorities—measures taken during peace-time—made 'maintained supply' possible. But even so, the results achieved during the past year have been due to the individual bravery of the men who operated the supply.

Lord Lytton expressed the hope that the day is not too far distant when we shall again think more in terms of 'development', because, despite the alarums and excursions of war-time days, the electrical industry has an eye—and a very constructive eye—to the future. In so far as anyone can visualize the problems of reconstruction with which we shall be concerned when the War is ended and the means available in solving them, the Association and various sections of the industry have given considerable thought to the many ways in which electricity can make its contribution to the planning and building of a Britain that will at least be a more comfortable place in which to live.

Economics and Finance

IN an address on "Finance and the War" given to members of the Parliamentary Labour Party at the House of Commons on November 9, which has now been published by the Economic Reform Club and Institute, Prof. F. Soddy stresses the importance of distinguishing between genuine and fictitious credit if we wish to put an end to recurring economic booms and slumps and periodic world wars primarily of economic or monetary origin. We live in a world of potential abundance beyond our unscientific ancestors' powers of foreseeing, but that abundance cannot be realized until we clearly distinguish between the creation and the acquisition of wealth. All genuine money reformers are unanimous in demanding that money should not be put into circulation as a debt arbitrarily terminable, and most, if not all, that it should be paid into circulation by the nation for full value received by the nation.

In Prof. Soddy's view, the issue of new money under existing economic conditions is merely one form of forced levy in kind, for new money is a new legal claim by the issuer to anything of equivalent value on the market, with nothing to show that it is new or that the possessor in acquiring it has not given up the equivalent value and so has the legal right to claim it back on demand. He urges that the public should be instructed by its representatives that whether Parliament levies upon it, for the purposes of national expenditure, by recovering from it some of the existing money, by taxation, or by issuing new money, the proportion between the two forms of levy in money and in kind is dictated solely by statistical considerations to maintain a constant price-level and the money in proportion to what there is to buy, so as to secure uniform and general prosperity.

Electrical Music

A PAPER on "Electrical Music" which was read on February 1 to the Midland Section of the Institution of Junior Engineers by Dr. W. Wilson and is published in the March issue of the *Journal* of the Institution, summarizes in a very thorough manner the chief existing methods whereby musical sounds can be produced electrically. The most important developments have taken place in connexion with apparatus which actually create musical sounds in the first instance. The first actual mention of music as produced by an electric source was in connexion with Duddell's 'singing' arc, at the end of last century. The resistance of an electric arc decreases as the current rises. The result is that instability is produced, in the absence of a ballast resistance; thus the arc is continually going out and rekindling. If an inductance instead of a resistance is used and the whole is shunted by a capacity, a tuned circuit is formed in which the current will oscillate at a definite frequency. In so doing the current between the electrodes will actually be reversed twice per cycle, the arc going out at each reversal. No serious musical instrument has developed from the singing arc, although it achieved fame as a wireless transmitter when slightly modified by Poulsen. Within the past decade the howling of a valve in a wireless set has been a common example of electrically produced sound and it forms the basis of two musical instruments. Theremin has reproduced the conditions of the oscillating wireless set in his 'etherphone'.

The second application of the oscillating valve is for the construction of a complete electronic organ, a good example of which is that designed by Coupleux and Givelet, and installed in a number of French churches. In this there are 120 valves, which are caused to oscillate singly, and to generate a full range of notes which are very rich in harmonics. A very successful electric organ was invented by Hammond in 1934. In this there are 91 small alternators all driven from a common shaft which is itself driven by a synchronous driving motor. The sound which accompanies a talking picture can be derived from a wave track printed upon the celluloid film, through which a beam of light is projected into a photoelectric cell. Organs have been designed on this principle. In conclusion, Dr. Wilson points out the many advantages of the electrical method of producing music, especially when the electronic organ is employed. The power consumption is very low, it being usually possible to obtain all the energy required by plugging all the supply leads into any ordinary lampholder. The first cost is low, being between 30 and 40 per cent of the ordinary pipe organ, the maintenance costs are low, and it can always be trusted to maintain its exact tuning. Its progress up to the present has been remarkable, and there is every reason to foretell an equally rapid expansion of its use in the near future.

Trends in Air Conditioning

IN an article in the *Electrician* of January 31, some significant trends in air-conditioning plants are discussed. The proved reliability of compact high-speed condensing units has made practical completely self-contained factory-assembled and tested 'packaged' air-conditioning units of ever-increasing size. Last year they reached 25 tons, and there is every indication that they will be increasingly popular. This trend began seven or eight years ago with small, compact, self-contained room coolers of about half a ton capacity, which were offered almost as soon as compact condensing units were developed. Later came the so-called store-type coolers, package units containing a condensing unit, evaporator, fan, and controls, completely piped, wired, charged and tested at the factory. The success of these units and the development of suitable compact, high-speed, condensing units has led to the more recent factory-assembled-and-tested central plant units of 7½–25 tons capacity. Those incorporate the features of a carefully engineered and installed central plant air-conditioning system, but are self-contained in a sturdy steel frame. All piping work, oven vacuum dehydrating, charging and testing of the system are under strict factory conditions. The units are usually placed in a stock room at the rear of a shop, in the basement, or on a balcony, and are connected to the occupied space by means of a suitable duct system.

Radio Traffic Control in America

A NOVEL plan to bring traffic signals into cars in the form of distinctive tones corresponding to the 'stop' and 'go' lights, may in time make a car-radio a legal requirement on every car in the United States. In its present form, this traffic-control system uses the existing car radio tuned to 550 kc., thus making the system immediately available for the six million cars now equipped with auto-radios, though eventually a special small set would be employed with fixed tuning to the highway safety-signal frequency. By the use of this signal, the driver, instead of letting his attention wander from the roadway in his search for traffic signals in unfamiliar territory, would hear a pleasant low tone as long as the lights were green. When red comes on, in all cars in that section of the roadway an interrupted high note would be heard similar to that caused by a crossing signal.

Recorded messages can be used for continuous repetition of a message. The small highway transmitting unit, which may be mounted on a telephone pole or a traffic light stanchion, makes use of a magnetic tape sound-recording device. A distinctive sign placed on the street in advance of a given radio zone attracts the attention of motorists to the radio system which they are approaching and gives them the frequency to which to tune their set. By means of this device, traffic can be diverted to a secondary thoroughfare from crowded highways, preventing jams before cars have a chance to pile up, and drivers can be warned of speed limits or of emergency in case of fire or accident.

Data of Seismology

FROM the Government of India Meteorological Department comes the valuable *Seismological Bulletin* for October–December 1939. Interpretations of readings of the seismograms from Agra, Bombay, Calcutta, Colombo, Dehra Dun, Hyderabad, and Kodaikanal are given. Furthermore, J. H. Sil at Poona has collected 58 non-instrumental reports of shocks, five being in October, eight in December, and the remainder in November. Three of the reports noted earthquakes reaching intensity 9 on the Rossi-Forel scale. By far the strongest shock was on November 21, 1939, at about 11 h. 1 m. G.M.T. At Gilgit stones fell from the mountains, and dust spread all over the valley. At Drosh intensity 9 was reached, whilst at Srinagar the walls of the observatory and other buildings cracked.

The *Seismological Bulletin* of the Riverview College Observatory (New South Wales) for July, August and September 1940, has also been received. The Observatory is equipped with three Wiechert and two Mainka seismographs, the interpretation of the seismograms from which are given. The shock of July 31, 1940, was felt at Cape Nelson, Papua. The earthquake of September 12, 1940, was felt at Rabaul, New Britain, also in the Kokopo district, and at Wide Bay, Pondo, Namatanai and Buka. To this earthquake there were several strong after-shocks. The shock of September 21, 1940, was felt at Queanbeyan, New South Wales, but did no damage. Some deep-focus shocks were recorded, and some slight shocks lacked interpretation, since the area is to some extent troubled with microseisms.

Earthquakes near America

THE United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has made a preliminary determination of the epicentres of the earthquakes of February 9 and February 11. The former had its initial time 9h. 44·1m. G.M.T., and on a basis of reports from 22 seismographic stations the epicentre appeared to be at latitude 40·7° N., longitude 125·4° W. This is in the Pacific Ocean just off the coast of California, in a well-known seismic region. The latter had its origin time 14h. 35·4m. G.M.T., and on a basis of reports from 18 seismographic stations the epicentre was calculated to be latitude 14·5° N., longitude 94·0° W. This is in the Pacific Ocean almost due west of Guatemala in Central America, also in a well-established seismic zone.

University of London: Certificate in Natural History

THE University of London has now published amended regulations (applicable for the duration of the present emergency) for its certificate of proficiency in natural history. The new scheme takes advantage of the fact that large numbers of urban teachers are now located in the country or at the seaside, and so presented with an opportunity of natural history study in the field which, under normal peace-time conditions, would have been impossible. The requirements embrace a directed course of private reading at home, attendance at a practical laboratory course of two weeks duration in the summer, an approved plan of field-work suited to the student's locality to be written up in the form of a substantial essay, and examination. Copies of the regulations and syllabus can be obtained from the University Extension Registrar, University of London, at Royal Holloway College, Englefield Green, Surrey. Several local education authorities are prepared to consider sympathetically applications for financial grants-in-aid from teachers in their areas who wish to study for the certificate.

Occurrence of Larger Fungi in the Tropics

A BRIEF note by E. J. H. Corner (*Trans. Brit. Mycol. Soc.*, **24,** 3 and 4; Dec. 1940) again directs attention to the interesting question of the occurrence of the larger fungi in the tropics. His experience in Malaya is in emphatic contrast to that of G. B. Masefield (*ibid.*, **24,** 64–67; 1940), who had suggested that large fleshy fungi are scarce in number and variety in the tropics generally, and that representatives of some of the better known genera are scanty or absent. Corner's evidence is to the effect that larger fungi are abundant numerically as well as specifically and generically, but that "their fructifications are seasonal, developing quickly and rotting quickly, during the first rains which follow dry weather, and that if one is not able to visit the forest daily during the right fortnight, no trace of these fungi will be found. As for variety, I have found in Singapore some sixty species of *Boletus*, twenty-six species of *Russula*, twenty species of *Hygrophorus*, etc., etc." The evidence, in brief, gives a clear indication that tropical conditions are by no means unsuitable for the higher Basidiomycetes, but that the collector must be on the spot at precisely the right time.

Health of Zanzibar

IN his latest report, Dr. S. W. T. Lee, senior medical officer in charge, Zanzibar, shows that the health services for women and children are improving. The women's clinic is attended by 150–200 patients daily, and in four dispensaries in the country the same work is carried on. Routine medical and dental treatment is given to school children, who all suffer, however, from nutritional defects. School feeding in certain places over a period of three months resulted in improved weight, height and health, but the Government is unable to finance the adequate treatment of all school children. The work of ante-natal clinics has steadily increased, and out of nearly 1,300 cases there was only one death which was due to puerperal sepsis.

Dr. George Oliver, 1841–1915

DR. GEORGE OLIVER, a well-known consultant physician and an authority on the examination of the blood and circulation, was born at Middleton-in-Teesdale, Durham, on April 13, 1841, the son of a surgeon. He received his medical education at University College, London, where he came under the influence of Dr. William Sharpey, the professor of physiology, and University College Hospital. He qualified M.B. London in 1865, and in 1873 obtained a gold medal at the M.D. London examination. Eventually he settled in Harrogate and soon acquired an extensive practice. In 1887 he was elected a fellow of the Royal College of Physicians of London, before which he delivered the Croonian Lecture in 1896, and in 1904 founded the Oliver-Sharpey lectureship in honour of his old master, the object of which was "to promote physiological research by observation and experiment, and to encourage the application of physiological knowledge to the prevention and cure of disease and the prolongation of life". Oliver's aim throughout his career was to make medicine a more exact science than it had been hitherto, especially as regards the blood and circulation; and with that end in view he invented several instruments such as the hæmoglobinometer, hæmodynamometer and arteriometer. He also devoted much attention to the study of the glands of internal secretion, especially the suprarenals, in conjunction with Prof. Schäfer. He died at Farnham, in Surrey, where he had been living in retirement for some years, on December 27, 1915.

Institution of Chemical Engineers: Medal Awards

THE following awards were presented at the nineteenth annual corporate meeting of the Institution of Chemical Engineers held on April 4: *Osborne Reynolds Medal:* Mr. M. B. Donald, lecturer in (and at present in charge of) chemical engineering at University College, London, and joint honorary secretary of the Institution of Chemical Engineers, for meritorious services to the Institution during the year 1940; *Moulton Medal:* Mr. J. C. Farrant, of International Combustion Ltd., for his paper, "A Review of Certain Unit Processes in the Reduction of Materials"; *Junior Moulton Medal and Award:* Mr. S. A. Gregory, of Moussec Ltd., for his paper, "Plant Design in Microbiological Processes"; *William Macnab Medal:* Mr. J. V. S. Glass, of the Castner-Kellner Alkali Co. Ltd., for the best set of answers submitted in the 1940 associate-membership examination of the Institution.

Announcements

WE regret to announce the following deaths:

Prof. Herbert Freundlich, For. Mem. R.S., professor of colloidal chemistry in the University of Minnesota since 1938, on March 29, aged sixty-one.

Commandant J. G. Hackin, of the Free French Forces, formerly professor of archæology and Indian art in the Ecole du Louvre, Paris, by enemy action, aged fifty-four.

Prof. A. Lapworth, F.R.S., emeritus professor of chemistry in the University of Manchester, on April 5, aged sixty-eight.

Prof. J. S. Macdonald, F.R.S., emeritus professor of physiology in the University of Liverpool, on March 29, aged seventy-three.

THE forty-seventh James Forrest Lecture of the Institution of Civil Engineers will be delivered by Prof. E. N. da C. Andrade, Quain professor of physics in the University of London, on April 29. Prof. Andrade will discuss "The Mechanical Behaviour of Solids".

FOLLOWING a long and severe illness, Lieut.-Colonel W. A. Vignoles has been obliged to relinquish his appointment as senior managing director of Messrs. Evershed and Vignoles, Ltd. Mr. J. C. Needham succeeds him in that capacity, and Mr. M. Vines and Mr. D. D. Walker have been appointed additional managing directors. Colonel Vignoles worked as an apprentice with the predecessors of the Company, W. T. Goolden and Co., joining that firm nearly fifty years ago in the autumn of 1891.

DR. HERALD R. COX, principal bacteriologist of the United States Public Health Service, has been unanimously nominated by the Theobald Smith Award Committee to receive the 1940 Theobald Smith award, consisting of a bronze medal and a sum of £200, for his outstanding research on Rickettsia diseases.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Origin and Spacing of Slip Bands

SLIP bands on plastically deformed crystals are very much more equidistant than would correspond to statistical disorder; except in the first stage of deformation, their spacing fluctuates around a mean value which is usually between $0{\cdot}5\ \mu$ and $10\ \mu$. This remarkable phenomenon seems to have a simple explanation. Consider a crystal lattice subjected to a shear stress σ which produces the elastic strain $s = \tan \alpha = \sigma/G$ (G is modulus of shear). Suppose that slip takes place in the slip plane p–p (see accompanying diagram) over an area the linear dimensions of which are great compared with the atomic distance, but small compared with the size of the crystal. The slipped area is surrounded by a dislocation zone D,D, and the stress in its immediate neighbourhood has fallen to a small amount which we assume to be zero. The question is, how far the zone of greatly diminished stress stretches on the two sides of the slip plane.

For a rough estimate, we replace the curved lattice lines AB by two straight lines, one being tangential to AB in points A remote from the disturbed zone, and the other tangential in the point B where the stress vanishes. In other words, we assume that the stress vanishes on each side of the area of slip in a zone of width $d = BC$, and then suddenly assumes its initial value σ. The width d of the stressless strip is easily determined. On one hand, the horizontal shift of the atoms at the slip plane is $BC \tan \alpha = d.s$; on the other hand, it must be at least half of an atomic distance a in the direction of the slip. Thus the smallest value of d is given by

$$s.d = 1/2\ a,$$

or

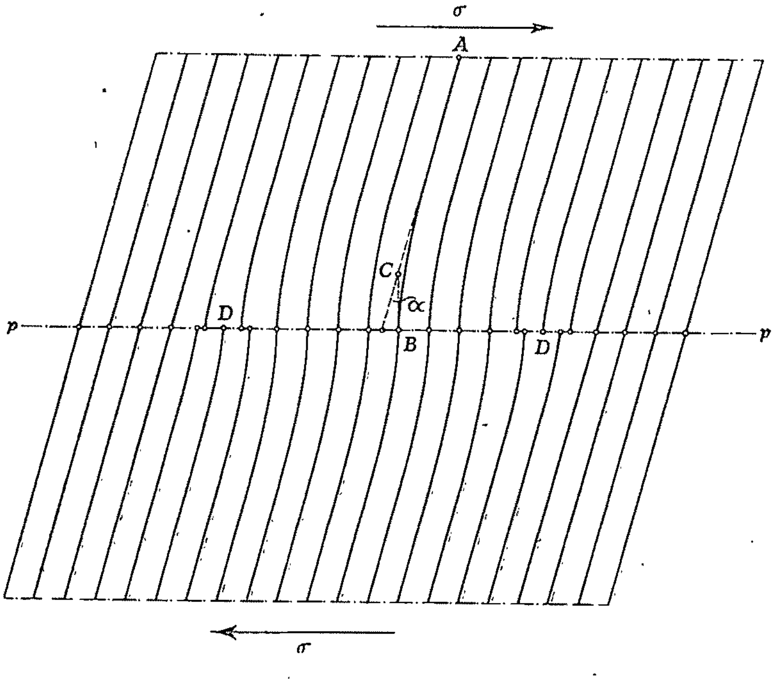
$$\sigma.d = 1/2\ Ga. \qquad (1)$$

In other words, a patch of slip inhibits further slip in a zone of thickness d on each side by annihilating the stress there, and we have to expect that the minimum spacing of slip bands at the stress σ will be d, as given by equation 1.

A better approximation for d may be obtained by calculating the minimum stress which makes two dislocations (the edges of the slipped patches), situated in slip planes the distance between which is d, move past each other. For the special case of parallel straight lines of dislocation, this calculation has already been done by G. I. Taylor[1], with the result

$$\sigma/d = 1/2\pi.Ga \qquad (2)$$

which differs from (1) only by the factor $1/\pi$.



The best-known example of very regular slip bands is that observed by Straumanis[2] on small crystals of zinc grown from vapour. The glide strain was, according to the microphotographs, about 50–60 per cent; the corresponding resolved shear stress[3] is about 160 gm./mm.[2]. With $G = 4{\cdot}08 \times 10^6$ gm./mm.^{2} and $a = 2{\cdot}66 \times 10^{-7}$ mm., equation 2 gives $d = 1{\cdot}1\mu$; the mean value of d, as observed by Straumanis, was $0{\cdot}8\ \mu$.

For different crystals, the stresses needed for plastic deformation generally increase with increasing G, so that the values of G/σ vary within comparatively narrow limits. This explains why the observed spacings of slip bands are usually of the order 10^{-4} cm., a value obtained from (1) or (2) by substituting typical values for G, σ, and a.

According to (1) or (2), the spacing of slip bands should be inversely proportional to the shear stress, except in the first stage of the deformation, when the bands are not close enough to influence each other. This has, in fact, been observed by Yamaguchi[4] on extended aluminium crystals. The product $\sigma . d$, calculated from the measurements of Yamaguchi, has values between 4·9 and 8·7 gm./mm., while (1) gives 0·35 and (2), 0·12. This is probably due to the fact that the slip bands on Yamaguchi's crystals did not extend over the full circumference of the crystal, but consisted of an echelon-like pattern of short overlapping lines, and their number was determined by counting the bands which intersected a perpendicular straight line of unit length.

According to the derivation of (1), the spacing of the slip bands directly reflects the atomic structure of the material; from the spacing of the slip bands and the corresponding stress an estimate of the atomic distance a could be obtained.

An estimate of the molecular shear strength σ_m is given by the formula[5]

$$\sigma_m . b = 1/2\pi . Ga, \qquad (3)$$

where b is the spacing of the lattice planes parallel to the plane of slip. Comparison with (2) shows that the spacing of slip planes is the spacing of the parallel lattice planes, enlarged in the proportion of the molecular shear strength to the actual shear stress.

(1) or (2) may prove of great usefulness for calculating, from the spacing of slip bands, the true internal stresses in individual grains and at grain boundaries in deformed polycrystalline materials. So far these stresses have been inaccessible to measurement.

With a relationship like (1) or (2), the problem of work hardening and creep in a crystal containing an unknown number of active slip planes is reduced to that of work hardening and creep in single slip bands. Together with a new experimental method for the direct measurement of the distribution of slip over the crystal, recently worked out in this Laboratory[6], this should open the way for the solution of the fundamental problem of plastic gliding, the determination of the number of lattice planes actively involved in the deformation.

E. Orowan.

Cavendish Laboratory,
Cambridge.
March 5.

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[1] Taylor, G. I., *Proc. Roy. Soc.*, A, **145**, 379 (1934), first line from top.

[2] Straumanis, *Z. Krist.*, **83**, 29 (1932).

[3] Schmid, E., and Boas, W., "Kristallplastizität (Berlin, 1935). Fig. 124*b*.

[4] Yamaguchi, K., *Sci. Pap. Inst. Phys. Chem. Res.*, Tokyo, **8**, 289 (1928).

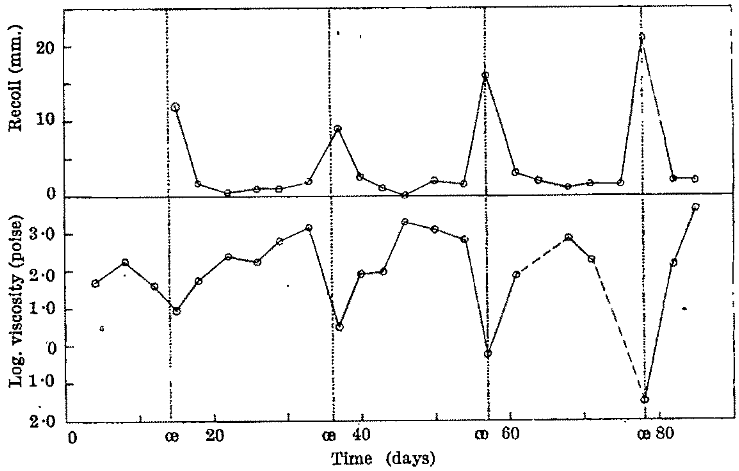
[5] Orowan, E., *Proc. Phys. Soc.*, **52**, 8 (1940).

[6] To be published shortly.

Rheological Properties of Bovine Cervical Secretions during the Œstrous Cycle

The secretions of the cervix of the cow in different reproductive phases have been described by Woodman and Hammond[1] and Hammond[2]. In œstrus, the mucus in the cervix and upper vagina is plentiful and fairly fluid, while in mid-cycle it is greatly diminished in amount and is more viscous. The characteristic stickiness of pregnant secretions has been proposed as a rough test for pregnancy (Marshall and Hammond[3]).

We are making a quantitative study of certain rheological properties of these secretions, which, although not true fluids, give approximately linear flow-curves in a Scott Blair emptying-capillary viscometer[4], doubtless owing to a convenient cancellation of opposite curvatures. The viscosities vary over such a wide range (order 70,000 : 1) during the œstrous cycle, that any reproducible viscosity figure is satisfactory.



Since in this instrument the rate of emptying under constant pressure of an initially full capillary is measured, the linearity of the flow-curves indicates that there must be a marked work-hardening of the material compensating for the known fall in viscosity produced by rising shearing force per unit area. This work-hardening is accompanied by a very large 'flow-elasticity'[5] in the case of œstrous samples, which can be measured in terms of the recoil of the meniscus in the capillary when pressure is suddenly released. The œstrous samples are also remarkably 'spinnbar'[6]. Hammond[2] had already noted the 'stringy' nature of œstrous secretions.

The figure shows the viscosities (plotted logarithmically) and the recoil in mm. for one cow during several œstrous cycles, dotted lines indicating œstrus as observed by the herdsman. Similar effects for a number of other animals have been observed.

Since the flow-elasticity alone gives a clear indication of œstrus and can be determined much more rapidly than can the viscosity, a simple apparatus has been designed ('œstroscope') for use in the cowshed, in which a 5 ml. hypodermic syringe is attached to a narrow glass tube (diam. 2 mm., length 10 cm.) which is filled with secretion by suction. The tube is slowly emptied by pressure on the plunger at a steady rate of about 5 mm./sec., a side-tube closed with the thumb serving as a means of releasing the pressure sharply. The recoil of the meniscus is measured on a millimetre scale.

The secretion samples, which are taken by hand from the neighbourhood of the cervix in the upper vagina, are best homogenized before use in the viscometer or œstroscope by squeezing several times between two glass plates. It is hoped that this technique will serve as an indication and a means for the prediction of œstrus in cows. Further work on samples from pregnant cows is in progress.

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S. J. FOLLEY.
F. M. V. COPPEN.
F. H. MALPRESS.

National Institute for Research in Dairying,
University of Reading.
March 11.

[1] Woodman, H. E., and Hammond, J., *J. Agric. Sci.*, **15**, 107 (1925).

[2] Hammond, J., "Reproduction in the Cow" (Camb. Univ. Press, 1927).

[3] Marshall, F. H. A., and Hammond, J., "Fertility and Animal Breeding", Bull. Min. Agric. and Fish. No. 39 (1937).

[4] Scott Blair, G. W., *Koll. Z.*, **78**, 19 (1937).

[5] Szegvari, A., *Z. Phys. Chem.*, **108**, 175 (1924); Ostwald Wo. and Malss, H., *Koll. Z.*, **63**, 305 (1934); *ibid.*, **67**, 219.

[6] Erbring, H., *Koll. Beih.*, **44**, 171 (1936), etc.

Sensitivity of the Dark-adapted Eye during a Prolonged Period of Observation

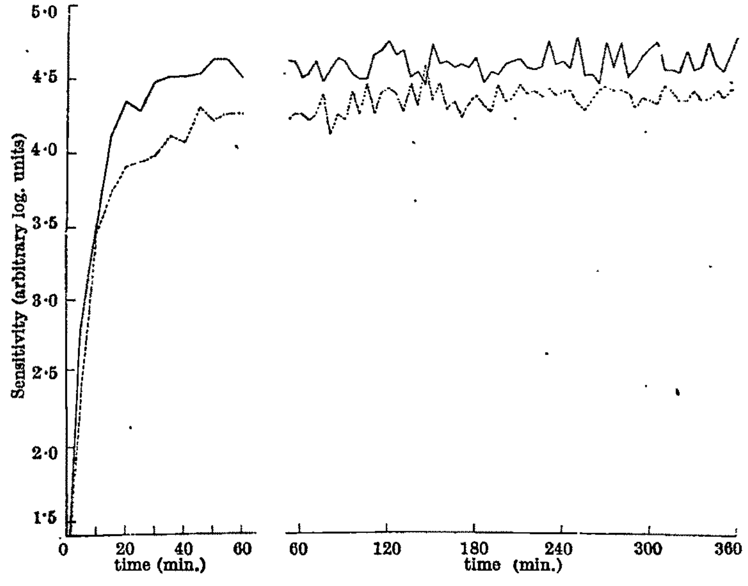
Two related problems of dark adaptation which have important practical applications, but which have received little or no attention, are (1) whether maximum sensitivity, once attained, will last more or less indefinitely, and (2) whether the course of adaptation is affected by fatigue. The experiments here described were carried out to obtain information on the second point, and if the results proved negative, on the first as well.

Observations on the absolute threshold for light intensity during the process of dark adaptation were made by means of Nagel's adaptometer[1], the technique being that described by me elsewhere[2]. Readings were taken following 10 minutes preliminary light adaptation, at intervals of 5 minutes throughout two sessions of 6 hours each, two weeks elapsing between the sessions. I, having participated as subject or experimenter in about seventy experimental dark adaptation sessions, acted as subject. The sessions here described took place following an ordinary day's activity (teaching, research, etc.), ending with 3 hours fire-watching duties, the exact times being 10 p.m.–4 a.m. on the first occasion, and 10.30 p.m.–4.30 a.m. on the second. During the session some black coffee and plain biscuits were taken. (The vitamin A content of these was negligible, and no observable effect on the readings was produced.) I experienced the usual signs of sleepiness, but no acute discomfort.

On the first occasion adaptation was carried out in complete darkness, in the ordinary way. On the second, it was carried out during continuous stimulation with diffused red light, as described in reference[2]. The light was bright enough to read by, though not with ease. The results of both sessions are shown in Fig. 1 and the accompanying table. The ordinates on the curves in Fig. 1 are a measure of sensitivity in arbitrary logarithmic units, corresponding to the reciprocal of threshold intensity at the time of each reading, and representing successive logarithmic steps below the maximum intensity of the adaptometer light. The figures in the table show mean sensitivity measures during each successive hour of the session. From the dispersions of these (as well as by observing the course of the curves) an indication of fluctuation or variability may be obtained. It will be seen that there is a slight upward tendency in both curves throughout the test period, there being in each case only one hour showing a mean reading lower than

	Adaptation during darkness			Adaptation with red light		
1	2	3	4	2	3	4
1	4·245	*		3·895	*	
2	4·612	0·0171	+0·367	4·329	0·0196	+0·434
3	4·625	0·0148	+0·013	4·397	0·0195	+0·068
4	4·614	0·0130	−0·009	4·411	0·0107	+0·014
5	4·638	0·0218	+0·013	4·397	0·0101	−0·014
6	4·648	0·0175	+0·010	4·407	0·0078	+0·010

1. Hour of observations. 2. Mean sensitivity during hour. 3. *P.E.* mean. 4. Increase or decrease over previous hour. * Readings during first hour show normal expected rise, hence their dispersion is meaningless.



COURSE OF DARK ADAPTATION

——— during darkness (initial reading 0·85);

.... with red light stimulation (initial reading 0·94).

N.B. Curves in two portions, with 10 minutes overlap common to both; time scale in second part one-half that of first.

that for the previous hour. These differences, however, are not statistically significant, the probable errors of these differences (not here noted) being in many cases greater than the differences themselves.

The following conclusions can be drawn :

(1) Maximum dark adaptation may be maintained for at least as long as 6 hours. That no falling-off occurs is in accordance with the assumptions or findings (over shorter periods) of most experimenters[3].

(2) The almost complete adaptation previously[2] noted during stimulation with red light can also be maintained over this test period.

(3) Ordinary fatigue at the end of a normal day's sedentary work has no effect on the adaptation process, as measured by the maximum 'level' attained. Nor is the accuracy of observation, as shown by the dispersion of the readings during successive periods, affected. In fact, in the second of the sessions here described, variability became progressively less.

In short, results obtained with a single practised subject suggest that it is possible, at least for some individuals, to maintain accurate observation in the dark-adapted state during a protracted period of enforced wakefulness.

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University of Edinburgh.
March 5.

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[1] Nagel, W. A., *Z. Augenhk.*, 17, 201–216 (1907).

[2] In an article to be published in the *Brit. J. Psychol.*

[3] With a few exceptions, notably Kravkov and Semenovskaja, in "Visual Sensation and Perception" (State Psychol. Inst., Moscow,) 138–152 (1935).

Relation between Colour and Permeability of Insect Cuticles

The same chemical process has been shown by Fraenkel and Rudall[1], Pryor[2], and others, to be responsible for the darkening and the hardening of insect cuticles. Hence the physical properties of the cuticle in light and dark varieties of the same species may be expected to differ. Yellow mutants of *Drosophila pseudo-obscura* and *subobscura*, and less markedly of *D. melanogaster* and *simulans*, lost weight in a dry atmosphere more rapidly than the wild type, whether they were alive or dead, and the dead yellow mutants regained weight more rapidly after drying. The yellow mutants died more rapidly in a dry atmosphere. Similarly the black and ebony mutants of *D. melanogaster* lost water more slowly than the wild type, and survived longer in a dry atmosphere.

The bearing of these results, which will be published in full elsewhere, on the selective advantage of melanism in insects, is obvious. In particular they may account for the surprising frequency, noted by Buxton[3], of black insects in deserts.

H. Kalmus.

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at
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[1] *Proc. Roy. Soc.*, B, 128, 378–407 (1940).

[2] *Proc. Roy. Soc.*, B, 129, 1–35 (1940).

[3] "Animal Life in Deserts", London (1923).

Early Exploration of Kent's Cavern

In amplification of the biographical note on the Rev. J. MacEnery in Nature of February 15, p. 202, it may be noted that a demy octavo edition of "Cavern Researches", etc., edited from the original manuscript notes by E. Vivian, was published in 1859. According to the preface to this issue, MacEnery was compelled, after a second appeal, to abandon the project of publishing his researches owing to lack of adequate financial support. Indeed, as MacEnery acknowledges the help he had received in his excavations from several clergymen, including the then Bishop of Bath and Wells, it is unlikely that fear of ecclesiastical censure had anything to do with his decision to refrain from publication.

At the sale of MacEnery's effects a Mr. Lear of Lawrence Place purchased a lot of sermon notes among which, after many years, the above manuscript was accidentally discovered by Vivian, who published extracts from it in the *Torquay Directory*. Afterwards the manuscript was bought by a Mr. W. Long who gave it to Vivian with a view to publication. The notes were in a very rough state but they were rearranged by their editor "as far as practicable in a connected series" without any additions ; the notes on Berry Head cavern were missing.

A large paper edition is stated to have been published, illustrated by sixteen plates which had been previously executed at the expense of the Very Rev. Wm. Buckland, Dean of Westminster.

H. V. Thompson.

32, Queen's Road, Hartshill,
Stoke-on-Trent.

The large paper edition of "Cavern Researches", which is a quarto volume with seventeen plates, and the smaller demy octavo, are in the Library of the Torquay Natural History Society. The former volume has twenty-five pages of letterpress and the latter seventy-eight pages.

The larger volume was published by E. Vivian in 1859, who in the preface mentions that the profits of that edition would be placed at the disposal of the Society, and as the seventeen plates were all executed in his life-time it does not appear that Mr. MacEnery would have been put to much expense in having the work published. His patrons, the wealthy family of Cary of Tor Abbey, surely would have helped their chaplain of nineteen years service had they been sure of his ecclesiastical position if he had required merely their financial assistance, but it is not at all unlikely that as he was a Roman Catholic he would have found it difficult to secure an 'Imprimatur'.

Harford J. Lowe, honorary secretary of the Torquay Natural History Society, in vol. 3 of the Society's *Journal* writes : "Circumstances combined with the want of encouragement and help from the representatives and guardians of his science frustrated his design, while there was also, no doubt, some apprehension of the new facts seriously affecting some of the traditional foundations of the 'Faith' . . . He shrank from such responsibility which ill-health would make appear greater and more serious, and so his sense of duty to Science was outweighed by his doubts and fears respecting its public use and benefit".

A. H. Ogilvie.

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The Museum, Torquay.

LANDMARKS IN CHEMOTHERAPY

THE forty-ninth Bedson Lecture was delivered by Prof. C. H. Browning at King's College, Newcastle-upon-Tyne, on March 11, the subject being "Landmarks in Chemotherapy". After defining chemotherapy and summarizing its position in 1900, Prof. Browning traced the search for synthetic compounds with curative action in infections due to trypanosomes, spirochaetes, malarial parasites and bacteria. The first great advance was the discovery of trypan red, with which Ehrlich and Shiga (1904) cured a surely fatal infection due to certain trypanosomes in mice. It had the disadvantage of staining the body tissues and was of little practical value; but it led to Bayer-205, a colourless symmetrically substituted urea derivative. In the case of the latter the ratio of the maximum tolerated to the minimum curative dose is very large; any change, however slight, in its molecular structure causes a great diminution in its activity. It is the most effective drug for the cure of the African forms of human trypanosomiasis, provided that treatment is begun early. About the same time as the discovery of trypan red, the organic arsenical atoxyl was shown by Thomas at Liverpool to be active against trypanosomes *in vivo*. Although inactive *in vitro*, it becomes active in the test tube on reduction to the trivalent arsenic state. Therefore it seems that the drug is reduced in the body or even inside the trypanosome itself. The outcome of the investigation of arsenicals in Ehrlich's laboratory was salvarsan and its derivative neosalvarsan. The latter, especially from convenience in use, has come to be the most important drug in the treatment of syphilis.

For the treatment of malaria, in addition to quinine, Ehrlich and Guttmann in 1891 found methylene blue to be active in the quartan variety. In 1926 Roehl showed that a quinoline derivative, plasmoquine, was effective; it destroyed the sexual stage or crescent of the tropical variety, which is resistant to other drugs. Schulemann (1932) introduced atebrin, an acridine derivative which, like quinine, acts on the asexual stage. It is noteworthy that both these synthetic anti-malarial drugs possess the same sidechain—$NH.CH\,(CH_3).(CH_2)_3.N(C_2H_5)_2$—although they differ in the stage of the parasite which is attacked.

Scientific attempts to destroy bacteria in the tissues date from 1867, when Lister experimented with some success on the use of crude carbolic acid in the treatment of compound fractures. This was an example of the application of a 'surface' antiseptic which could be brought into intimate contact with an infected site.

Up to about 1914 it was believed that an antiseptic must be a general protoplasm poison, harmful alike to the bacteria and the infected host. But this idea was disproved by observations with the newer antiseptics, such as acriflavine and proflavine. An example is afforded by Blake's experiments on trout ova infected with *B. salmonicida*; although carbolic acid is almost equally toxic to both, a concentration of 1 : 2,000 acriflavine will kill the bacteria without appreciably damaging the ova. Experimental streptococcal infections have also been successfully treated with acriflavine as well as certain quinoline compounds of the Schiff's base type (anils), the method being to inject the organisms into the abdominal cavity and then after an interval to follow up with a solution of the drug. Such antiseptics are valuable for the treatment of local infections of wounds, especially as preventives.

As regards the treatment of general bacterial infections, in 1911 Morgenroth and Levy showed ethylhydrocupreine (optoquine) to be active against experimental pneumococcal infection in mice; this observation was of scientific interest only. The first compounds of practical value were the azo dyes derived from *p*-aminobenzene sulphonamide, used by Domagk, such as "prontosil soluble". Tréfouel *et al.* showed that it is the sulphonamide part of the molecule which is effective, and that the removal of the part linked by the azo grouping does not cause loss of activity. Sulphanilamide itself is fairly soluble and rapidly absorbed and excreted. Analogues, such as sulphapyridine, which have proved very useful clinically, are much less soluble and more slowly absorbed, so tending to maintain a more continuous action. Compounds of this class which are effective against streptococci in experimental infections, may fail with staphylococci.

While these drugs have revolutionized the treatment of meningococcal meningitis and gonococcal infections, and have profoundly modified the course of pneumonia, they appear to have little effect on some other infections, for example, tuberculosis.

CONTROL OF TRANSPORT IN GREAT BRITAIN

WHILE Lord Stamp and his fellow chairmen of the four great railway companies in Great Britain have made spirited replies to some of the criticism levelled at the railways in recent months, rail transport is only one aspect of a problem which has aroused widespread concern. The importance of transport in war has been well brought home to us in recent months by the measures designed to save shipping space, and the severity of the attacks on British and Allied shipping. It is only in a limited sense, however, that we have learnt that the power to transport may be the decisive factor, although its bearing on our blockade of Germany has been indicated by Dr. Hugh Dalton. That blockade can only be decisive if transport difficulties, intensified by bombing, reduce the enemy's supplies in his vast territories below what Dr. Dalton calls the 'distributional minimum'. We have yet to appreciate as a nation that the transport problem is a simple problem, and must be governed by national, not by commercial, considerations. The transport services in Great Britain must make their utmost contribution to the war effort without regard to other considerations.

This argument is the basis of Bulletin No. 5, "The Organisation of Transport for War", issued by the Vigilance-for-Victory Group (10 Hertford Street, London, W.1). It recognizes that some of the progressive slow-down of transport has been due to conditions directly imposed by the War, and that the transport services have done their best to overcome their formidable difficulties within the limits imposed by the nature of the transport service. While, however, it is of the utmost importance from the point of view of national defence that our internal lines of communication shall be organized and operated at the highest efficiency, there has been a falling off in efficiency which has substantially reduced the capacity of the transport services. Moreover, the system of internal communications must be considered as a whole. The greatest efforts of the most experienced officers with purely local functions can be frustrated by action in distant parts of the country without anyone being able to relate cause to effect. Failure to combine the highest professional experience with power and responsibility is the root cause of the situation which the recent appointments of two regional port directors are intended to correct.

The bulletin makes the point that transport difficulties are due to failure to co-ordinate transport supply with transport demand on a properly planned and organized basis, as was indeed indicated in Lord Stamp's address. Our present lines of communication are unnecessarily complicated because they have in the main been built up around, or in competition with, a method of railway operating, which however inevitable in the past, is no longer so, and is in itself complex. Statistics of the Ministry of Transport show the very low efficiency of railway operation and serious under-employment of equipment, and this is due to the methods of operating and the very low speed of movement. The delay in clearing ports and distributing supplies, even before mass air-attacks, was due to lack of ways, not of means. There appears to be no real shortage of equipment. The prime cause of the absence of organization is the persistent assessment of transport operations by their financial results and not by their service to national requirements.

The bulletin accordingly proposes that for the organization of our lines of communication for war purposes, the present advisory committee or consultative committees of the Minister of Transport should be abolished and replaced by a Transport Executive Council. Composed of professional transport officers of skill and experience, who would become full-time servants of the State, and functioning very much as the Board of Admiralty and the Army Council or the Air Council, this Council would handle the management and planning of transport services as a whole and decide the broad policy and major problems. The Minister of Transport would be president of the Council, which would directly control all forms of transport, each member of the Council being responsible for a group of departments. Regional organization would also be a matter for the Minister and the Transport Executive Council. While the precise form of regional organization would depend largely on the policy adopted to co-ordinate different forms of transport, it is probable that the simplest and most direct form of control would be through regional transport executive officers, who would exercise full authority over all forms of transport.

The War Transport Council just set up by the Minister of Transport would appear to be a step in the direction envisaged by the "Vigilance-for-Victory" Group.

HUMUS FROM HABITATION WASTES

By Prof. R. H. Stoughton,

University of Reading

THE disposal of the waste materials incident to the existence of mankind has always been one of the major problems of any large civilization. Primitive man, leading a nomadic existence, left his waste wherever he might be. As community living developed, the midden became more and more a necessary part of living conditions, and when towns grew the disposal of waste products began to assume the proportions of a real difficulty. The value of animal and human excreta for the improvement of the soil and for plant growth was discovered by many races; the possibility of returning decomposed garbage to the soil similarly seems to have been thought of at many times in history; the combination of the two appears, however, only to have been practised in early times by the Chinese.

Western civilization developed the disposal of refuse, first by dumping and later by incineration; millions of tons of organic matter are, in one or other of these ways, destroyed at the present time. The wasteful disposal of excreta was later in coming. Until the advent of water-borne sewerage, night-soil still went back to the land, and a great deal of the nitrogen taken from the soil by plants was returned to it in this way. Then came modern systems of sewage disposal and all this 'went down the drain'. But water-borne sewerage, though bringing hygiene and health, brought also new problems of disposal, and thousands of tons of sludge containing only about five per cent or less of solid matter accumulate at every sewage works, and must be got rid of, either by dumping in the sea or by slow drying on extensive beds.

In the meantime our soil is crying out for organic matter. Without organic matter a soil is 'hungry'; its moisture content, the essential key to plant growth, fluctuates wildly with the rainfall, and with its water its soluble mineral content varies. The agriculturist and horticulturist, recognizing the need for organic matter, have for centuries used dung and green manure as the source. Now the supply of animal manures is growing less every year; surely it is time something was done to stop the destruction of all the organic matter in habitation wastes and to convert them into a form suitable for restoring the organic content of the soil.

Lieut.-Colonel F. C. Temple in a recent paper[1] discussed these difficulties and outlined the attempts which have been made to solve the problem of the economic utilization of these waste materials. The

Indore process of which so much has been heard is one such method though, in itself, it contains nothing original; it does not, in any event, deal with the problem of sewage sludge, but is concerned with the combination of vegetable wastes with night-soil and animal excreta. A process is, however, actually being worked at Maidenhead and Leatherhead whereby screened dust-bin refuse, which as it stands is too dry to compost, is used primarily as an absorbent of sewage sludge, which is too wet, and the two together are composted to give a product rich in organic matter and capable, in the soil, of being converted to that ill-understood complex which we term 'humus'. Colonel Temple made out a strong case for an extension of this kind of work, and pleaded for experimentation and a wider vision by municipal authorities. The discussion on the paper showed a sharp cleavage between those who, recognizing the great potential value of such products, wanted to see work directed to improvement and standardization of methods, and those who considered the problem already solved and wished for immediate installation of plant by municipalities.

The Agricultural Research Council, realizing the need for knowledge of what happens when these materials are brought together, has recently financed an investigation at the University of Reading on the preparation of such composts. Such points as the attainment of a correct carbon-nitrogen ratio for satisfactory fermentation, the influence of varying proportions of the two primary components and the proper balance between aerobic and anaerobic decomposition are under study. The problems presented are innumerable; the potentialities are so great as would justify the creation of a research centre for this kind of work alone.

One thing is clear, the product to be manufactured must be 'safe'; that is, it must be so far decomposed that when it is added to the soil, immobilization of nitrogen through diversion of the activities of soil bacteria must not occur, and the carrying-over of pathogenic organisms in the compost must be rendered impossible. The farmer must have no doubts about the materials; once such a product can be made with certainty, a new era in the disposal of habitation wastes will begin.

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[1] "Municipal Manufacture of Humus from Habitation Wastes". Paper read at a meeting of the Royal Society of Arts on January 29, 1941, by Lieut.-Col. F. C. Temple (*J. Roy. Soc. Arts*, 84, 215–228; 1941).

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(*not included in the monthly Books Supplement*)

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Catalogues

The Book of Dunns Farm Seeds, 1941. Pp. 28. (Salisbury: Dunns Farm Seeds, Ltd.)

Gentian Violet Jelly B.D.H. Pp. 2. (London: The British Drug Houses, Ltd.)

Your Camera Lens. Pp. 24. (Birmingham: Aldis Brothers, Ltd.)

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Applications are invited for the following appointments on or before the dates mentioned:

Assistant Professor in the Department of Glass Technology—The Registrar, The University, Sheffield (April 18).

Director of Education for the County Borough of Derby—The Director of Education, Education Office, Becket Street, Derby (April 18).

Graduate Assistant to teach Mathematics and General Science Subjects, and a Graduate Assistant to teach Mechanical Engineering Subjects at the West Hartlepool Technical College—The Chief Education Officer, Education Offices, Park Road, West Hartlepool (April 19).

Assistant Engineer for the Federated Malay States Government Railways—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9618).

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GEOLOGY AND THE COMMUNITY

A GENERATION ago geology was among the sciences which attracted a wide public interest; at the present time not only has public interest greatly declined, but also there are many workers in other sciences who are almost completely unaware of the content of geology. Yet at no time in the past century have geologists been engaged in pressing forward research in so wide a variety of subjects or engaged in so many investigations of fundamental economic importance. Nevertheless, the nature of their work is but vaguely understood by the general public, and they are not always consulted on problems in which they could give useful assistance, because those concerned are unaware that such matters fall within the competence of geologists.

This decline of interest in geology was used by Prof. P. G. H. Boswell to justify his departure from the traditional practice in presidential addresses to the Geological Society of London, of confining the address to a review of the progress of knowledge in a particular branch of geology; in the first part of his address, delivered on March 12, which he entitled "The Status of Geology", he reviewed the present conditions and suggested ways in which interest in geology may be revived.

Until a quarter of a century ago, the Science and Art Department of the Board of Education encouraged the formation of classes in a large number of sciences, and such subjects as geology, astronomy and physiology were then highly popular. While the work was elementary and the courses were open to criticism from several points of view, it must be admitted that they introduced a large number of citizens to the marvels and potentialities of science, and gave them a proper perspective of the history and activities of man. These courses exerted a cultural influence which was very widespread, and teachers whose outlook had been enlarged in such classes further assisted in the spreading of scientific knowledge. At least, the general public became aware of the existence of some of these sciences.

It is, of course, true that science teaching in schools has made much progress since those days, but to a great extent school science has come to mean physics and chemistry, with biology sometimes added; geology has only rarely been included. With the growth of specialist teaching in these sciences, honours graduates in physics and chemistry were in great demand: such graduates had rarely included geology in their curriculum, and thus were generally unable to continue the tradition of informal teaching which had previously served to keep alive an interest in geology. Therefore, in their impressionable years, while many pupils were left in ignorance of the elements of biology, nearly all were unaware of the very existence of geology. Consequently it is not a matter for surprise that the public should now be indifferent to geology.

The seriousness of this position has been recognized by geologists for some time, and efforts have been made to direct the attention of educationists to the problem. The dearth of geology graduates and the difficulty lately experienced in filling posts (especially in the petroleum industry) laid further emphasis on the need for action, particularly in relation to Empire needs, at a time when in the U.S.S.R., Germany and the United States large numbers of geologists were being trained. In 1935 the position was so grave that Section C (Geology) of the British Association pressed for the appointment of a committee to consider and report on questions affecting the teaching of geology in schools. Reports were published in 1936 and again in 1937: they directed attention to the claims of geology as a school subject, to its cultural value, to the advantage of its outdoor work, and to the demand for trained geologists, while they also made constructive proposals for the inclusion of geology in the School Certificate examinations, both as a separate subject and as a part of a general elementary science course.

It is as yet too early to estimate the prospects of a revival of interest in the subject through school activities. The Science Masters' Association, though composed mainly of teachers without special knowledge of or interest in geology, has readily recognized the importance of the subject by including it in its revised suggestions for a general science course ("The Teaching of General Science, Part II. Science Masters' Association, 1938). Since the War began, the evacuation of city schools to buildings with inadequate laboratory facilities, in rural areas which are often ideal for field work, has done something to stimulate an interest in the subject. But any further progress must depend on the supply of trained teachers, and here the position of the universities is involved.

The number of university students taking advanced courses in geology (apart from those designed for engineering and mining students) has diminished greatly in recent years. While there are several reasons for this decline, there is no doubt that it is due mainly to the growth of the Higher School Certificate examination in England and Wales, and to the granting of exemption from the first year of study in many universities to the holders of such certificates. Although this scheme may have worked well in the training of specialists in chemistry and physics, in existing conditions it has worked towards the elimination of those subjects which are not taught in schools. The choice of a student's university course was frequently made on the basis of the 'Higher' subjects taught in his school: he was 'no good at science' if he had not marked aptitude at physics and chemistry. Possibly this state of affairs would be changed if students were normally required to take a wider range of subjects at the university and to include at least one science which they had not previously taken at school; it is significant that in some Scottish universities, where an honours student in one science may be required to take courses in three or four other subjects, the numbers of geology students are still considerable.

For the more satisfactory teaching of general science in schools, it is clear that graduates having some acquaintance with four or more sciences (and a somewhat more special knowledge of one or two) are likely to be most successful. The growth in awareness of geology, if many students of other sciences learn something of its scope and methods, will be of great value both in education and in applied science.

It is probably owing to the lack of public awareness of geology that so few geologists have been given opportunities to assist in the war effort. Yet, Prof. Boswell emphasized, we hear of deplorable wastage of money and labour (and therefore of all-important time) which geological knowledge would have prevented if it had been applied; he thought that on every Divisional Intelligence Staff in the Army there should be at least one officer in whose training geology had found a place. When the organization of regional commissioners was set up, a geologist was attached as adviser to each commissioner, but apart from occasional inquiries little regular use has been made of geological knowledge. Yet during this time there has been great activity in establishing camps, works, shelters, etc.; the work would have been sufficient to occupy the relatively small numbers of geologists available, but for the most part they have remained unused, having to be content with the knowledge that their qualifications were set out on the Central Register; many have undertaken other service in which their special abilities are lost to the country. Meanwhile, it was noted, there are reports of "operations in which geologists have been given no opportunity to be effective—of works placed in unsuitable locations, camps and reception areas where water is inadequate and drainage unsatisfactory, water-logged trenches and air-raid shelters, and (as though rising in a crescendo of incompetence) the case of an ill-chosen aerodrome site".

The members of the Geological Survey have, of course, been active in a variety of ways, and have done admirable work on many problems which, unfortunately, owing to the exigencies of war-time publication, is not so widely known as it should be. They have been concerned with the investigation of mineral resources (particularly of supplies to replace those normally imported), of water supplies, drainage and other problems. But Prof. Boswell contended that the staff of fifty geologists, even with occasional collaboration of other geologists, is too small to cope with all the difficulties created by war-time activities. Further, he is of opinion that the total number of geologists (including suitably qualified amateurs) available in Great Britain is scarcely sufficient to deal effectively with the numerous problems and the large area to be surveyed.

Even at this stage in the War, there is no reason why it should not be more widely known that geological assistance is available: what is particularly desirable at the present time is that consideration be given to the widespread ignorance regarding the scope and content of geology, so that the available information will be utilized freely when plans for post-war reconstruction are being discussed. This can best be assured if geology regains its position in the educational schemes of Great Britain, so that an acquaintance with its achievements and methods is gained by a larger number of educated people, including those who will be engaged in administration as well as those who will themselves work in, or utilize, the materials of the earth's crust.

FEDERATION AND ITS IMPLICATIONS

Federal Tracts
No. 1: Peace by Federation? By Sir William Beveridge. Pp. 34. No. 2: Economic Aspects of Federation. By Prof. Lionel Robbins. Pp. 32. No. 3: The Colonial Problem and the Federal Solution. By Norman Bentwich. Pp. 32. No. 4: What Federal Government Is. By K. C. Wheare. Pp. 24. No. 5: The Philosophy of Federal Union. By C. E. M. Joad. Pp. 40. No. 6: Socialism and Federation. By Barbara Wootton. Pp. 32. No. 7: Federal Union and the Colonies. By Lord Lugard. Pp. 32. (London: Macmillan and Co., Ltd., 1941.) 6*d*. net. each.

THE wide measure of public attention which the idea of federalism has come to command since the outbreak of the War is already attested by a considerable volume of literature. Several alternatives to the plan proposed in Mr. Clarence Streit's "Union Now" have been closely discussed, and a good deal of attention devoted to problems and difficulties over which Mr. Streit appeared to pass too lightly. If, however, the precise form in which the idea was advocated by Mr. Streit is unlikely to find wide acceptance, the whole trend of events has given fresh urgency and importance to the concept of a union of States.

This urgency derives from two main sources. In the first place, it is realized that if we are to utilize the opportunity which the loosening effect of the War upon our corporate institutions gives us, the mental preparation which must form the basis of any sound plan of world order must be done now, even in the stress of war. Only so can we hope to avoid the mistakes which are bound to be made if we defer the problem until hostilities end and a policy and line of action are demanded without delay. In the second place, our exposure of the Nazi New Order of tyranny and slavery for the subject races should not lead us to overlook the extent to which some semblance of order is implied in such a domination. It imposes on us the obligation of offering to the dominated peoples, when released from Nazi tyranny, not the old disorder, but a new order of free peoples.

These reasons alone give pertinence to the discussions on world order and reconstruction which have been proceeding with fresh vigour during the past autumn and winter, and to the educational campaign which has been fostered by the New Commonwealth, Federal Union and other organizations. That educational work is indeed fundamental. If opportunities are to be seized by the statesmen of this and other countries when the time comes, they must be assured of the support of an informed public opinion, clearly understanding what is involved in any sacrifices of national sovereignty that may be required.

For this reason alone the admirable series of pamphlets which Federal Union has arranged to publish under the name of "Federal Tracts", with the view of promoting informed discussion of federation, is to be warmly welcomed. These pamphlets, of which the first seven have now appeared, are written by authorities on their subjects and express the personal opinions of the authors. Federal Union as an organization is not committed to the views expressed in any of the tracts, and the writers themselves, while interested in federal problems, will not necessarily be members of the Union.

The first two of these pamphlets are not new. No. 1, "Peace by Federation?" by Sir William

Beveridge, written in February, 1940, for private circulation, was included in the first series of "World Order Papers," published last autumn by the Royal Institute of International Affairs; Prof. L. Robbins' "Economic Aspects of Federation" was originally contributed to the symposium "Federal Union" edited by Mr. Channing Pearce and published by Messrs. Jonathan Cape last year. These two acute analyses of the possibilities and limits of federalism are now given to a wide public and form a fitting introduction to the series. Together with the fourth pamphlet in the series, "What Federal Government Is," by Mr. K. C. Wheare, they give a fair and concise account of the problems involved in federation as they present themselves to-day.

Sir William Beveridge, after discussing the problems involved in selecting the areas to be included in a federation, and the division of powers, outlines very briefly a federal constitution. Much of the interest of his contribution, however, lies in the line of approach which he suggests and his proposals for the new step and for dealing with the difficulty of Germany. His cautious approach is unlikely to satisfy the more ardent followers of Mr. Streit's school, but his insistence on a gradual approach and the necessity of limiting the area of federation will commend his argument to constructive minds. World federation, he holds, is for the millenium. Sir William is concerned with the next peace treaty and with the establishment of a super-national government adequately empowered to defend its authority and maintain the peace.

Federation will come when communities recognize a common interest, for which it is worth sacrificing something of their freedom. Sir William Beveridge does not indeed postulate that nations are even yet ready for federation. He sees no other proposal as likely to achieve order, and he rests his proposals on facts: the spectacular changes in the scientific and material equipment of mankind, making out of date old tribal groupings and isolations, and particularly the special revolutionary facts of the unification of Germany and of aggressive Communism in Russia. These facts between them have changed the conditions of peace in Europe and the forms of government required there.

This practical moderation is characteristic of the series and adds considerably to their educational value as a stimulus to thought. Mr. Wheare indeed lays much of his stress upon the difficulties of federalism. It has normally been difficult to establish a federal government. Its operation requires great skill and tact. Its success depends upon an enormous patience and capacity for compromise among the statesmen who work it. Swift and decisive government is impossible, and deep and dividing issues must be avoided. Compromise, conservatism and legalism must of necessity be the virtues and vices of successful federal government.

It is wise to recall the limitations and weaknesses of federalism when proposals to establish a new federal government are under consideration. Only by taking careful account of them can we avoid disillusionments or placing upon the federation a strain it is not fit or intended to bear. If federal government is not always appropriate or easy to work, it is at least government and order, and if the division of powers is wisely and carefully made, it should be possible to reap the advantages of federation while retaining the capacity for rapid executive action in the appropriate spheres which may be essential for efficiency. Federalism, after all, is not an end in itself, but a means of providing a system of government where people are prepared to surrender only certain limited powers and wish to retain other limited powers, both sets of powers to be exercised by co-ordinated authorities.

Few federations in fact are completely federal, and there is nothing to prevent the adoption of strict federalism in some matters and only a modified federalism in others. A written constitution is essential, however, for a federal government, and the amending process should be operated unilaterally neither by the federal government nor the State governments—a condition which obviously precludes any consideration of Germany under her present regime entering a federal system. Furthermore, a supreme court which determines the meaning of the constitution in case of dispute, and financial self-sufficiency for each of the co-ordinate authorities, are other essential features of a federal system of government.

Prof. Robbins, and also Mrs. Barbara Wootton in the sixth tract, "Socialism and Federation", cover much the same ground but from different points of view. Prof. Robbins urges the desirability of leaving to the constituent States as much economic freedom as possible and of eliminating the possibility of those conflicts of sectional interest which under independent national sovereignty might be causes of international friction. He urges that what restrictions or regulations are placed on migration and inter-State trade should be imposed by federal, and not State, authority. Similarly, though wide diversity in monetary system and industrial structure might be permissible within the federation, control of money and capital movements within the federation should be essentially a federal function. Again, federal permission or approval should be required for local collectivist experiments which involve restriction or discrimination.

"Socialism and Federation" is a defence of the thesis that socialism and federation are complementary. Social progress is contingent upon international order, and conscious and planned direction of economic life over a wide area is essential, in the opinion of Socialists, to achieve equality and prosperity. A federal constitution which gave concurrent powers to both State and federal governments to legislate on labour matters, providing only that in conflict the latter would prevail, might enable a system of federal minima to be combined with higher standards in the more advanced States while relieving the latter of fear of their low-standard neighbours.

Mrs. Wootton enforces her argument by referring to the decision about European unity which will confront us who reject the Nazi tyranny under which it has been temporarily imposed. Merely to break it is to forget the logic of twentieth century technique and the wider horizons of twentieth century citizenship, and to re-establish only disorder, tariffs, currencies and barriers. To adopt the alternative of transforming the Nazi empire involves a new political framework such as federalism provides.

The fifth pamphlet in the series, by Prof. C. E. M. Joad, "The Philosophy of Federal Union", should appeal to the scientific worker in particular. The philosophy of federal union, Prof. Joad points out, is largely concerned with the question whether the supercession of powers or transfer of functions from national governments to a federal government is possible or desirable, and he proceeds to an examination of the Fascist philosophy of the State, in which he shows that that philosophy is not only unsound and unscientific but also incompatible with federalism. The individual has rights other than those conferred upon him by the State and duties other than those which he owes to the State.

Prof. Joad argues that the State is not a final but a transitional form of human organization, one among many evolved in the course of man's history. Changes in human environment resulting from man's inventiveness have already made it a political anachronism. Man's advances are due to the individual and not to the State, which has hindered, opposed or suppressed rather than promoted creative thought. Indeed the power of the State has become a menace to human happiness as well as to creative thought, and the supercession of the State has become the crying need of our time. The rule of law can only be established if States are deprived of the power to set aside the authority of law as Federal Union proposes.

Prof. Joad, however, goes further. Federal union has a positive philosophy to offer. The outstanding defect of our civilization is the disparity between our powers and our wisdom, our technical knowledge and our virtue, our science and our ethics and politics. Our problem is that of so organizing our lives both as members of communities and as individuals that we may reap the benefit of the new opportunities of living that science has won for us.

Federal union offers its first contribution to the solution of that problem by enlarging the boundaries of the political unit so as to adjust it to the reality of the underlying economic structure. Moreover, in a world where habit has taken the place of principle and State worship has led to ethical anarchy, federal union offers in the brotherhood of man a creed to live for, and in the supercession of the obsolete form of organization which impedes it, a principle to live by. The ethics of federal union prescribe the duty of enlarging the sentiment of patriotism to include within the scope of its concern the members of other States.

Prof. Joad refers finally to the need for strengthening democracy with the conviction that only religion can command, and with the enthusiasm which only religion can generate. It may well be that federal union, he concludes, can only be achieved and the rights of the individual preserved, if the enthusiasm which religious faith can generate can be harnessed in its service. These Federal Tracts are well calculated to inspire that intelligent understanding of the problems involved which forms the basis, not only of an adequate plan and policy, but also of the conviction and enthusiasm required to ensure their execution.

The remaining two of the pamphlets deal with the colonial question. In the first of these, "The Colonial Problem and the Federal Solution," Prof. Norman Bentwich, reviewing the major problems which the colonial territories present, discusses the alternatives possible in a federal system, and emphasizes the impossibility of establishing a peaceful order with an approach to world citizenship, whether by federal union or any other way, unless we are prepared to renounce national advantages and privileges in governing territories inhabited by less developed peoples and to let people in other countries have a part with us. Lord Lugard, writing on "Federal Union and the Colonies", urges that centralized administration is not workable, and advocates supervision of Colonial economic policy by a standing committee of the Federal Council, similar to the Mandates Commission. He stresses the importance of the principle of equal opportunity and the prohibition of racial and religious discrimination, but strongly opposes some federal proposals such as those of Dr. Ivor Jennings.

R. BRIGHTMAN.

LIQUEFACTION OF GASES

The Separation of Gases
By M. Ruhemann. (International Series of Monographs on Physics.) Pp. xiii+284. (Oxford: Clarendon Press; London: Oxford University Press, 1940.) 21*s.* net.

IN the preface to this book it is stated that" it is high time that deep refrigeration received adequate attention in this country". Dr. Ruhemann has therefore written a volume to remedy this lack of knowledge on the part of British men of science, in order that the subject may be taught in the universities. Certainly the average textbook of physical chemistry does not deal in much detail with the working of liquid air and similar types of plant. The reason is quite obvious. The principles of the subject were worked out many years ago. They are expounded in all works dealing with the equilibria of vapour-liquid systems. But their application has become a matter of very specialized engineering practice, naturally confined to those concerns whose job it is to build and operate low-temperature refrigerating plants. It is not the function of the average university lecturer in physics or in chemistry to teach engineering practice to his students. The author's crusade for courses on "deep refrigeration" is therefore unlikely to be taken up with any great enthusiasm in Great Britain. None the less, the book provides a great deal of information which has not hitherto been dealt with in any connected manner. In this respect it is welcome to chemists and physicists alike.

The early chapters deal with the principles of the subject, first with the vapour-liquid equilibria of two-component systems, next with systems of three components. Much recent data are presented in convenient graphical form. There is a chapter on the thermodynamics of gas separation, particular attention being paid to the types of diagram most useful for discussing equilibria in this field. As might be expected, there are full descriptions of the various types of liquefiers, with estimates of the efficiencies reckoned in gallons of the desired liquid per kilowatt-hour expended. Unfortunately from a practical point of view, the capital cost and maintenance of the plant are left out of consideration. While the scientific efficiency is of great interest, the over-all cost of running a plant is the determining factor in its adoption in practice.

Several chapters are rightly devoted to the separation of air into oxygen and nitrogen in either liquid or gaseous form. The isolation of the rare gases is described, but as a matter of interest the details of the method of separation and purification would have been welcomed by the average reader, who would like to know just how the pure samples, now available commercially, are prepared. There is here no mention of the use of charcoal in manipulating and purifying rare gases. Such a method is, of course, unlikely to be used on a large scale, but knowledge of this kind is undoubtedly useful to those working with these gases. It must be mentioned that there is a chapter on the separation of helium from natural gases.

The liquefaction of hydrogen and of helium are unfortunately left out of account. Admittedly, only the favoured few now handle these liquids, but the technique developed for their production, manipulation and use is of the utmost interest to anyone likely to read a book on the liquefaction of gases.

The production of hydrogen and even of methane from coke oven gas receives great prominence, and cogent arguments are brought forward to show that hydrogen so produced for use in synthetic ammonia plants is an economic proposition. The plant, however, is so complicated that it seems unlikely that it would compete with alternative methods of making hydrogen - nitrogen mixtures of the required composition and purity. The isolation of the constituents of cracked gases in the petroleum industry is described in the last chapter of the book. This is a subject upon which much work will be done, but the paucity of published results makes it difficult for the author to give more than an outline of what has so far been accomplished.

Much of the more recent data and statements of fact given in the book are derived from Russian sources, although a certain amount is culled from the United States. There is, however, often a lack of references to the source of information. This makes it very difficult to assess the value of such statements. In a scientific book of this character, it is not sufficient to say that in the U.S.S.R. such a plant is working at a certain efficiency, unless the figures are backed by reference to a detailed description of the plant in some journal of repute.

The volume is produced in the customary excellent style of the Clarendon Press.

H. W. MELVILLE.

THE MAN OF SCIENCE AS ARISTOCRAT

By H. G. Wells

THE other day I listened with great pleasure to Sir Richard Gregory's Aldred Lecture[1], and admired once again his instinct for bringing together into the most fruitful association, facts and consequences lying far apart, and extracting wide suggestions and new problems from the assemblage. But the readers of NATURE do not need to be reminded that Sir Richard was a brilliant editor so that without any sacrifice of its world-wide scientific usefulness he also made this weekly journal a medium of interpretation and understanding between one type of specialist and another and between specialists in general and the man of general intelligence and broad curiosity outside the ranks of the specialist worker. The Royal Society began as an assembly of curious gentlemen, amateurs all, and how else could it have begun ? It could include Pepys, for example, to his great benefit certainly and maybe to its own.

I find that very relevant to Sir Richard's discussion, and Prof. Hill's stimulating address on scientific co-operation[2] comes in at a different angle to the set of problems Sir Richard has set going in our minds. He gave us no solutions, and it may be there is no simple comprehensive final reply to the questions he had started. Is there a real hard-and-fast difference between discovery and invention, between pure and applied science, between philosophy and science, between the professional and the amateur, between gentlemen and players, between the inventor and the patentee ? One can imagine a sort of preposterous Royal Commission sitting to define the boundaries and calling a fantastic crowd of witnesses. The discussion would slop over into the world of artists and writers and of all who deal in thought and knowledge. Is it within the honour and dignity of a writer to write an advertisement ? Or to write a book pandering to popular sentimentalities he despises ?

But if we admit the boundaries are indefinable, it is still arguable that there are centres to this peripheral vagueness. There are types and groups and individuals, almost completely disinterested in their contribution to human achievement, and there are others whose activities are deliberately directed to gainful research. Again we have another group whose end is neither the good, the true or the beautiful, but a definite practical end. Thinkers unduly influenced perhaps by the materialist interpretation of history have it that every step in invention and discovery has been a response to a very present need. Man had long wanted, to practice agriculture in a methodical manner, and so he took up astronomy ; he wanted to fix the boundaries of his fields in a wide flat plain and so he stretched out his hand into the unknown, and behold ! geometry was there. He wanted to go places and so he leapt upon the hitherto merely edible horse and supplemented its insufficient sturdiness by breeding and the wheel. I put these things from one angle, but one can quite easily turn the point in the other direction. When man rumbled off in his first chariot, was he looking for something practical he needed urgently, or was he just looking for trouble ? No community would have kept and fed an astronomical and geometrical priesthood unless it had fulfilled a vital practical need. But how far the priest created the need he also satisfied is one of those head-spinning questions best dealt with by a gathering of convivial anthropologists after dinner. For the answer to almost all these conflicting questions seems to be : "Well ; to a certain extent—*yes*."

But to push further into the luminous fog into which Sir Richard and Prof. Hill have lured me, and which I find so stimulating that it has kept me awake at nights, it is, I think, possible to define the practical problem to which their thoughts are directed. It is the protection of progress. They both think that human living should be and can be made more abundant and happier by the progress of discovery and invention, and they are agreed that that progress is only possible in an atmosphere of world-wide free expression, publication and exchanges. Free expression is the breath of human hope.

But neither of them stops at that. Sir Richard in particular upsets a whole beehive of notes of interrogation beyond that primary demand. The driving force responsible for the rapidity of human progress in the past century and a half has been, he evidently thinks, discovery. Exploration, fundamental research, discovery, is the root from which the immense wealth of modern invention springs. Lying abed, at nights I have disputed that, but it is true. I thought of the bicycle as an invention that owed nothing to discovery, that might have happened anywhen. The idea of the hobby horse, one might think, is old as the wheel ; a fair road was necessary, but there were good roads in the early empires, and I would not be surprised to find a hobby horse in a Sumerian burial mound, just as one might find a prehistoric glider in Crete. There would have been nothing fundamental in adding a treadle to the hobby horse. The penny-farthing boneshaker was equally open to man, therefore, except—except that that big wheel was impossible, and it was impossible because of the backwardness of metallurgical practice. The 'safety' was still more impossible because of the lack of skill and material for gearing. The invention of the practicable bicycle, like the glider, has had to wait throughout the ages therefore until the fruits of scores of remote explorations and discoveries had filtered down to practical exploitation. It could not have happened earlier than it did, and only as a consequence of that fundamental work.

So that the preservation, multiplication and cultivation of the 'pure' discoverer is the primary solicitude of all of us progressives, and it becomes an inquiry of primary importance to the liberal thinker to reveal what are the political and social circumstances that will produce this type in maximum abundance and satisfactory activity.

Last winter I flew over most of America. I visited a number of universities and among others the great technological organization at Pasadena. I saw the great lens of the Lick Observatory being rubbed slowly to a perfect curvature, and I brought my knowledge of the chromosomes of the fruit-fly up to date with my old friend Prof. T. H. Morgan. The atmosphere was charged with considerable political excitement because of the presidential election, and I found a very curious divergence of opinion between the elder and the younger men of science. The older men had found their opportunity through the endowments provided by rich men, and they seemed to be unable and unwilling to contemplate any other way of sustaining research. Except in social and economic science, the yoke of the patron had been easy to bear, an almost imperceptible weight. The endowment paid its money for distinguished achievement and the man of science had a free hand, and the more he carried himself as a distinguished mental aristocrat, the more he gave satisfaction. But in our world of rapid revolution the very foundations of this conditional security are threatened, and these elder men of science are, so far as my knowledge goes, politically Tories to a man. They have a real and justifiable fear of the State politician, of journalistic denunciation, of a vast paralysing network of control. They do not want to change the rule of the wealthy patrician for that of the political commissar.

This, however, is not the case with the progressive recalcitrant sciences, and among the younger men of science in all departments I found a lively disposition to get on with a new world and to find in an extension of federal activities in the way of research and educational facilities a substitute for the spontaneous and rather incalculable generosity of the now deflated wealthy. I will not take sides here and now. I report what is happening merely to raise the question of how the scientific worker is to adjust his pride and honour to this new and dangerous change in his sustaining conditions.

He may have to face not simply difficulty and poverty but bitter frustration. To do that he will have to set aside any pseudo-modesty that afflicts him. By resolving to become a primary research worker he decides that he is one of a necessary *élite*, an aristocrat in a democratic world. How can he decide that ? If he feels that his research work is better worth while than anything else in the world, then probably it is worth while, and if he does not feel that, he had better turn to something 'with money in it'. He must not wait for a grant or anything, he must go ahead with it, whatever it is. Curie could do that. Think of the poverty of his life throughout, and how he died, and then think of all that the world owes to him. This world to-day is his.

My old friend, York Powell, told me years ago, "Your first duty is to the gift within you. It does not matter whom you offend nor how you sacrifice your popularity. Do the thing that you are impelled to do. Everything else is secondary to that impulsion." What holds good for the writer, holds good for the primary research worker. It is the same problem.

The philosophy for the essential research worker I submit is a stoical aristocracy. I note with interest and a certain cynicism the suggestions of our authors for gratuities and patents. Do any gratuities get to the original discoverers ? I doubt it. Years ago I took up the idea of Diplock's pedrail and applied it to the problem of trench warfare. Diplock was the originating inventor. I described a tank and how it could be used to break an entrenched deadlock, in 1903, in a story called "The Land Ironclads". Years afterwards I discovered that some enterprising gentleman had secured a considerable gratuity as the "inventor" of the tank. His imagination stopped short just where my story stopped short. He had no idea of how to use the tank, and the British Higher Command made an utter mess of the job. It might have decided the war in 1916. I was kept in the dark as to what was going on or possibly I might have broken out with some saving suggestions. Later on, de Gaulle was quite unable to teach the elderly French generals the principles of mechanized warfare, and the Germans last year were the first people to make an intelligent use of the tanks. But anyhow my gratuity (or Diplock's) was intercepted. That is likely to happen constantly. Interception will become an art if gratuities multiply, and I do not see how one can circumvent the 'Smart Alecs' without a tedious amount of litigation and worry that would distract one from one's proper work.

Much the same thing applies to patent rights. I doubt if many patents give any protection to original inventors. There also I have had some slight but edifying experience. I wrote a book about a "time traveller", and about that time the new "instantaneous" photography appeared. Mr. Paul came along to me and we took out a provisional patent that would have made us practically the ground landlords of the entire film industry. We nearly patented films! We did not go on with the patent. Happily. Otherwise we should have found ourselves corruptingly rich, and a heavy incubus on the development of the cinema. It would have been a mere fluke, a lucky anticipation of unsuspected possibilities, a hold-up.

I can't answer for Mr. Paul, but I have no doubt that all that ill-gotten gain would have demoralized and wasted me completely. My egotism would have been inflated. It would have snatched me from honest work and brought out the latent arrogance and detestableness in my nature. I might have become a Press peer. I might have endowed and dominated futile *ad hoc* research. I might have joined the privileged class which can treat men of science and civil servants and the like as though they are Greek slaves. Happily, it did not dawn upon us until too late what a vast commercial opportunity we were missing. Our provisional patent lapsed.

Those particular experiences make me equally sceptical of the effectiveness of the gratuity and the patent. It seems to me that in the end the research worker, the philosopher, the author or the artist must fall back upon his innate conviction of the supreme value of his work. His ultimate resource is pride. With that he must be prepared to sustain himself against adverse conditions. He must do his best always. He must endure the bludgeonings of fate. Those who detect his quality may be able to put laboratories, transport and material at his service, but they must not insult him with offers of prizes and profits and honours, they must fight for that unrestricted freedom of expression without which he is muffled and made ineffective, and the rest lies with him. He has to hold to it and insist that so far as his work goes he is an aristocrat, an angular aristocrat it may be, but the only kind of aristocrat the new world has any use for. It matters very little if he is poor, gauche or shabby. Without any pretence of false modesty he has to bear himself as an aristocrat not only within himself but among his peers, whether they like it or not. He is the key man of the New World.

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[1] The Royal Society of Arts Aldred Lecture, 1941: "Discovery and Invention", by Sir Richard Gregory, Bt., F.R.S.

[2] Address by Prof. A. V. Hill, "Science, National and International, and the Basis of Co-operation", NATURE, 147, 250 (March 1, 1941).

DIFFUSE REFLEXION OF X-RAYS

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THE diffuse reflexion of X-rays by crystals was the subject of a discussion held by the Royal Society on February 6, when the theoretical and experimental evidence was reviewed by a number of speakers. By way of introduction to the views put forward concerning the origin of diffuse reflexions, a short historical summary of the subject will not be out of place.

The presence of stray reflexions, spots or streaks, is familiar to anyone with experience of taking Laue photographs. In many cases they are due to crystal imperfections, strains, etc., caused in the process of mounting the crystal or in cleaving it to a convenient size for examination. But even after care has been taken to eliminate all such causes, there still remain reflexions the presence of which is not explicable by the usual theory of crystalline diffraction. Such reflexions were first recorded by Friedrich[1] in a Laue photograph of sylvine in which short, faint streaks appeared running radially through the most intense Laue spots; he did not, however, offer any explanation of their presence. Ten years after Friedrich's photograph was published, Faxén[2], as a result of a theoretical investigation, suggested that these streaks were due to the disturbance of the regular geometrical atomic pattern by thermal agitation of the atoms. His work and that of Waller[3] was so complicated that the implications of the theory have lain concealed for some fifteen years beneath a mass of mathematical symbols.

In the interval the attention of experimenters has been focused on the verification of the simpler theories of Darwin[4] and Debye[5], in which the effect of temperature in diminishing the intensity of the normal reflexions was investigated. This

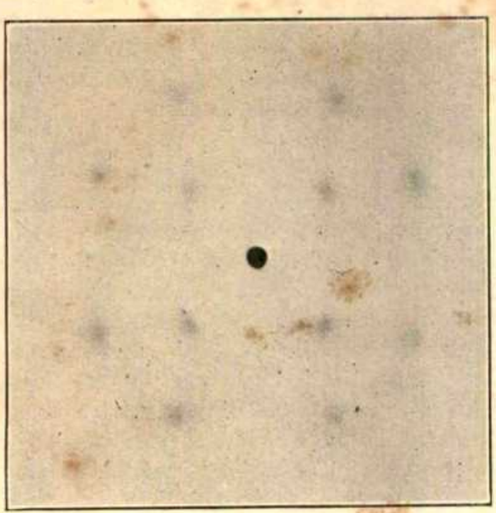

Fig. 1.

Aluminium at 500° C. Monochromatic silver $K\alpha$ radiation parallel to a cube edge.

concentration on the X-ray reflexions associated with integral indexes (*hkl*) was natural at a time when the application of the new method to the study of crystal structure opened up such a wide field for research. The very weak background reflexions were rightly regarded as of secondary importance.

Within the last five years, interest in these faint reflexions has been aroused and they have been studied simultaneously in several laboratories. Some of the anomalous reflexions are due to crystal imperfections caused during growth or to the occurrence of a chemical reaction in the solid state. Examples of these two phenomena are to be found in minerals[6] and in metals[7]; in both cases the background reflexions are to be ascribed to minute imperfections in the crystal.

There are, however, background reflexions which are associated with the thermal vibrations of the atoms in the crystal. These are of fundamental importance because they form an integral part of the spectrum of the crystal and cannot be separated from the normal reflexions. It was shown by Preston[8] in 1939 that Laue photographs of aluminium, sodium chloride, magnesium oxide, zinc and diamond had background reflexions which became more intense as the temperature of the crystal was raised. One of these photographs is reproduced in Fig. 1; it was obtained by means of a monochromatic beam of silver $K\alpha$ radiation falling on a single crystal of aluminium at 500° C. perpendicular to a cube face. There ought to be no spots on this photograph because the Bragg condition is not satisfied for any crystal plane; the faint pattern of spots with fourfold symmetry is due to the thermal waves in the crystal. Preston suggested that the pattern was due to the presence in the crystal of small groups, consisting of an atom and its neighbours, which diffracted X-rays more or less independently.

Slightly in advance of Preston's investigation, Laval[9], using the ionization spectrometer and monochromatized copper and molybdenum radiations, carried out an investigation of the background intensity and its variation with temperature, using six different crystalline substances. Unfortunately, the full account of his work was published in a journal not very readily accessible to physicists and has for that reason been overlooked. If we represent the normal spectra of a crystal by the points of which the co-ordinates are integers (*hkl*) in reciprocal space, then we can describe an important part of Laval's work as a study of the distribution of intensity near these points and the determination of surfaces of constant intensity surrounding them.

In the United States, recent interest in background reflexions seems to have originated in the publication of a Laue photograph of rock salt by Wadlund[10]. This picture showed a remarkable system of streaks similar to, but very much more intense than, those recorded by Friedrich in the photograph of sylvine already referred to, but almost certainly arising from the same cause. The matter was taken up from the theoretical side by Zachariasen[11], and the effect is ascribed to the thermal vibrations of the lattice, the formal explanation following the lines of the Faxén-Waller theory.

Sir C. V. Raman[12] and a number of collaborators have described their observations of anomalous reflexions from diamond and other crystals. The new spots are referred to by these authors as 'modified' reflexions, their presence being ascribed to an effect analogous to the Raman effect in the

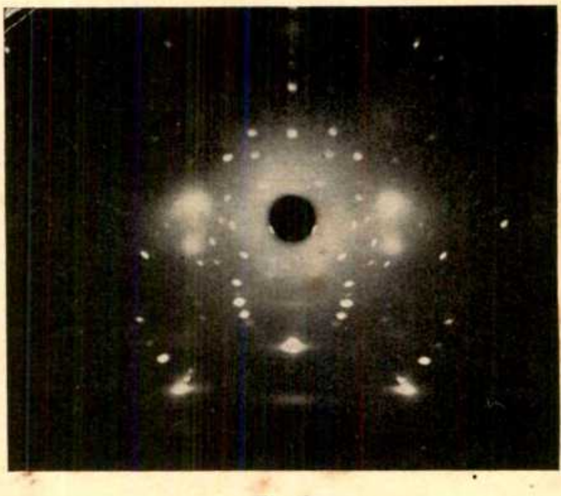

Fig. 2.

Laue photograph of sorbic acid.

Note diffuse spots of different shapes, due to 'layer'- and 'chain'-type planes.

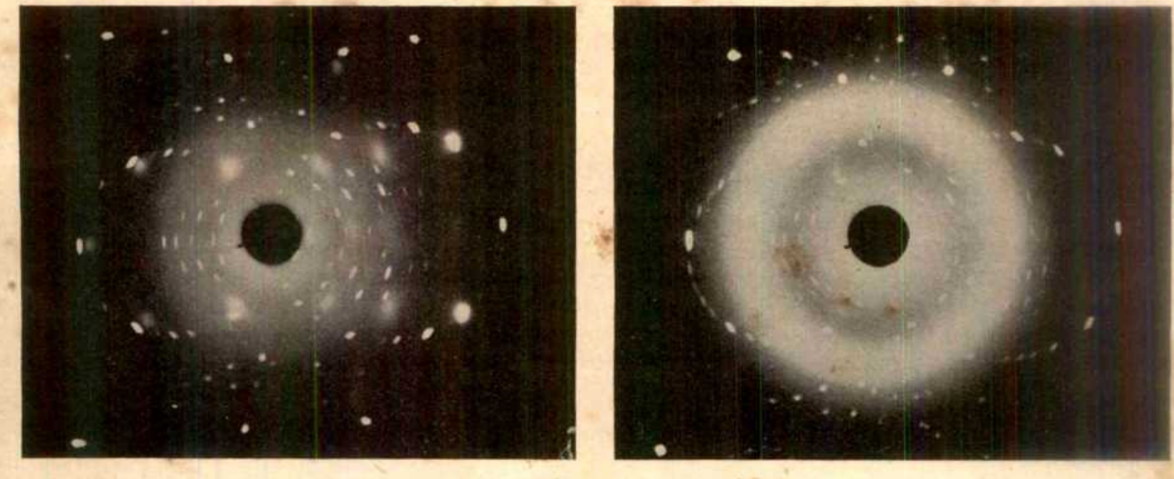

Fig. 3.

LAUE PHOTOGRAPH OF α-RESORCINOL.

(*a*) Showing arrangement of diffuse spots in layer-lines. Crystal enclosed in fine 'Cellophane' tube, at room temperatures. Photographs before and after liquid air experiment are identical.

(*b*) Same orientation and exposure, at liquid air temperatures. Intense diffuse ring due to liquid air stream. Note almost complete disappearance of diffuse spots and improvement of Laue picture.

optical region of the spectrum. The 'modification' implies a change of frequency accompanying diffraction, the change being too small to measure. In essence, Raman's interpretation agrees with that of other workers in ascribing the anomalous spots to the presence of elastic waves in the crystal. It is not at the moment clear whether Raman considers the waves to be due partly to temperature vibrations or solely to excitation by the passage of the X-ray beam through the crystal. The dependence of the intensity of the spots on temperature was, however, demonstrated for sodium nitrate.

The most recent, and much the most comprehensive, study of temperature spots comes from Dr. K. Lonsdale[13], a full account of whose work will appear in the *Proceedings of the Royal Society*. She has obtained a large number of photographic records of the diffuse spot effect, some of which have recently been exhibited at the Royal Institution. Her main conclusions may be briefly summarized as follows :—

(1) The diffuse spots may be seen on X-ray crystal photographs of every kind and measured on the ionization spectrometer. A much longer exposure is generally required than in the case of a Laue photograph. She found it convenient to use the 5-kw. tube of the Davy Faraday Laboratory and sometimes the 50-kw. tube to record the spots.

(2) The diffuse spots are due to the diffraction of the characteristic X-rays, as others have found.

(3) Each diffuse spot lies close to, or in the same position as, the Bragg reflexion from some crystal plane, the indexes of which can be found by a slight rotation of the crystal ; and the spots are found only under conditions in which the corresponding Bragg reflexion can be found by such a rotation. This means that the pattern of diffuse spots corresponds very nearly with the pattern of Bragg spots formed when the crystal is oscillated through a small angle on either side of the position in which the diffuse spots were recorded.

(4) The intensity of a diffuse spot is related to the intensity of the corresponding Bragg reflexion and to its separation from it.

(5) Radial streaks on Laue photographs are generally due to diffuse reflexion of white radiation.

(6) Monochromatic radiation sometimes produces non-radial streaks, notably in the case of benzil. Sometimes patches of diffuse scattering appear and other anomalies not yet explained. 'Layer' and 'chain' structures give diffuse spots differing markedly in shape and in other respects ; the study of these diffuse spot patterns may provide valuable assistance in structure determination (Fig. 2).

(7) The intensity and extent of the diffuse spots are strongly affected by temperature, as Preston and others have shown. They disappear at the temperature of liquid air. As the diffuse spots strengthen, the Laue spots weaken, and vice versa, all the effects being reversible (Fig. 3, *a* and *b*).

(8) Considering the effect in terms of reciprocal space, the diffusely reflecting regions surrounding each reciprocal lattice point are not, in general, spherical, but are extended along certain planes and axes. This is proved by the existence of non-radial streaks and accounts for the small movement of the streaks and diffuse spots when the crystal orientation changes. The configuration of diffuse spots observed in diamond and sylvine demonstrates this and shows that the plane of

diffuse scattering is not always coincident with the plane of incidence.

Besides arriving at these general conclusions, Mrs. Lonsdale has considered, in the paper referred to, the relations of the intensity, shape, size, position and persistence of the spots to the nature, structure, perfection, orientation and temperature of the crystal, to the radiation used and to the conditions of photography.

Sir William Bragg[14] has analysed the pattern of diffuse spots produced by sylvine and has found that they correspond to the diffraction effects to be expected from a simple cube of eight atoms. He points out that in all cases hitherto examined the diffuse spot pattern agrees closely with the true diffraction pattern of the crystal under monochromatic radiation, as given by the formula for intensity :—

$$I = (\Sigma m_1 m_2 \cos {}_1\varphi_2)\,\frac{\sin^2 p\varphi_a/2}{\sin^2\varphi_a/2}\cdot\frac{\sin^2 q\varphi_b/2}{\sin^2\varphi_b/2}\cdot\frac{\sin^2 r\varphi_c/2}{\sin^2\varphi_c/2}$$

In this formula m_1 and m_2 represent the scattering powers of any two centres in the unit cell, and ${}_1\varphi_2$ represents the difference in phase of the waves which they scatter, each centre to be reckoned in conjunction with itself as well as with all the others. The quantities φ_a, φ_b, φ_c, are the differences in phase associated with the three principal translations of the cell, and p, q, r, the number of times that the respective translations are repeated.

If p, q, r, are large numbers, the intensity will be relatively extremely small unless the three denominators are simultaneously very close to zero. This complete coincidence requires the special disposition of the crystal with respect to the incident ray which is prescribed by Bragg's law. But if p, q, r, are small, as in the case of the small groups suggested by Preston, there will be a regular pattern which might be visible if there were enough groups, and would possess, in the main at least, all the properties so far found to be possessed by the diffuse spot pattern, for example, the connexion with the oscillation photograph. The effect of temperature might be due to a change in the number of small groups, as Preston has suggested. The principal translations can be deduced from the pattern as Sir William Bragg has shown for potassium and sodium chlorides, calcite and benzil.

Sir Lawrence Bragg considers Preston's idea of diffraction by small groups of atoms does not fully account for the phenomena observed, and that this is so because it leaves out of account the fact that the groups form part of an extended crystal structure and so cannot be regarded as scattering independently. The observed positions of the diffuse spots obtained with monochromatic light may be explained by saying that diffraction takes place when the phase of reflexion passes *near* a point of the reciprocal lattice, and is not restricted to the special condition of passing exactly through it. This is merely an alternative way of expressing Preston's condition in reciprocal notation. Now, if a crystal is broken up into a number of small independent units, roughly parallel, the points of the reciprocal lattice are smeared out, and the intersection of this by the sphere of reflexion gives diffuse spots ; hence the success of the 'group' idea in accounting for Preston's original photographs and the much more complex ones obtained by Mrs. Lonsdale and analysed by Sir William Bragg. This cannot be the complete explanation, however, because along with the diffuse Preston spots one obtained *sharp* Laue spots and *sharp* spots in a rotation photograph. The whole phenomenon must be described by saying that at each point of the reciprocal lattice there is a sharp central spot surrounded by a diffuse cloud ; both spot and cloud must be ascribed to the same crystal, and both must be explained simultaneously.

The distortion of an extended lattice by heat-waves provides the explanation. The superposition of a periodic heat-wave of wave number n upon a lattice of wave number N produces periodic components in the crystal structure of wave numbers $N \pm n$, $2N \pm n$, $3N \pm n$, etc. Corresponding X-ray reflexions can thus be obtained, and appear as a pair of 'ghosts' on either side of the main reflexion. The whole complex of heat vibrations exactly fills the reciprocal lattice space with these ghosts, and it can be shown that the ghosts nearest to the reciprocal lattice points are the strongest, because the longest heat-waves displace the atom to the greatest extent. Hence the reciprocal lattice at low temperatures is a series of discrete points, whereas at high temperatures a cloud of ghosts fills all the space and is strongest near the points of the lattice, which latter diminish in strength but remain sharp. This is precisely what is observed. If the crystal effectively broke up into groups of atoms, sharp Laue or rotation spots would no longer exist ; their persistence at high temperatures shows that we must take the phase relationship right through the crystal into account.

That the small groups which apparently render a simple and accurate account of the observed spots do not appear explicitly in the formal theory does, at first sight, throw very serious doubt on their existence. Darwin, however, suggests that the fact of their absence from the analysis is not in itself sufficient ground for dismissing the idea as false. To illustrate this point, he draws an analogy with the analysis of the rise and fall of the tide in an estuary. Owing to local conditions there might, for example, be a long period at low water when the level did not change appreciably. The Fourier analysis would predict this feature of the tidal change quite accurately, but would not indicate the precise physical cause (the draining of a large expanse of sandy foreshore) which produces the effect. In the same way the Fourier analysis of the thermal disturbance of the crystal would predict the intensity of X-ray reflexion correctly, but, as information concerning the phases is lacking, the presence of groups could not be predicted.

In discussing the theoretical problem offered by the experiments on background reflexions on Laue photographs, Prof. Max Born inquired whether the phenomena can be explained by the well-established theory of scattering or whether new assumptions are necessary. He observed that the fact that Sir William Bragg's formula represents the position of the spots so well, suggests that it should appear as a result of a theory more satisfactory formally, than the assumed presence of small groups of atoms. It seems that an improved theory of the effect of thermal vibrations should provide an adequate explanation of the observations. The important fact emerges that just as the Laue spots, or Bragg reflexions, determine the geometry of the lattice, so the background pattern is a complete image of the main features of the dynamics of the lattice.

The observation of effects similar to those discussed above has been recorded by Charlesby, Finch and Wilman[15] using the method of electron diffraction. Their experiments show that for molecular crystals, such as anthracene, the thermal vibrations of the lattice produce a background pattern. The effect is somewhat similar to that of a vapour in which all the molecules are oriented and produce a pattern which should reflect the symmetry of the molecule. It appears that the X-ray effect is not identical with that observed with electrons, for some of Mrs. Lonsdale's photographs of benzil do not produce a pattern characteristic of the benzene ring when the crystal is examined in a suitable orientation.

The whole subject of background reflexions is evidently one of very considerable interest and no little complexity; further investigation, both theoretical and experimental, should provide information regarding the structural imperfection of crystals, whether of thermal or other origin.

In preparing this article I have been greatly helped by Sir William Bragg, Mrs. Lonsdale and Sir Lawrence Bragg. It is with pleasure that I acknowledge my debt to them.

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CENTENARY OF THE PHARMACEUTICAL SOCIETY

THE centenary of the foundation of the Pharmaceutical Society of Great Britain occurred on April 15, 1941. Thirty years ago, congratulating the Society on its seventieth anniversary, Nature observed that it was "an event of considerable interest, which is not wholly confined to those who practise the art of pharmacy". The same may be said, with emphasis, on the occasion of the centenary. It is no small thing even for an institution to survive ten decades. The mere fact is proof of its stamina and its usefulness; a hundred years on and how many fall by the way. The Pharmaceutical Society has gone from strength to strength, and it may be said to-day that its place among the nation's useful foundations was never more secure and its service to the State never more highly esteemed or more needed.

Just as among individuals, a man often owes his virility and his good purpose in life to his parents, so does the Pharmaceutical Society owe much to the scholarly Quaker, William Allen, F.R.S., who has been justly called its father, and was its first president. He was the owner of a chemist's shop in Plough Court, Lombard Street, London, and it seems strange that in the days when the practice of pharmacy was in the hands of a heterogeneous mass of tradespeople, most of whom were without scientific knowledge and but poorly equipped with the materials of their business, there should be found among them a man of high scientific attainments, a fellow of the Royal Society, one of the founders of the Askesian Society for practical research, who had lectured at the Royal Institution and at Guy's Hospital. Besides all these things, William Allen was confidential adviser to Edward, Duke of Kent, the father of Queen Victoria ; it was on the advice of this City druggist that the Duke consented to place his property in the hands of trustees, the consent being given on condition that William Allen was one of them.

There is little wonder, then, that those members of the craft of pharmacy who were sufficiently enlightened to see the need of organization chose this outstanding personality as their leader ; and the Society having been established by a resolution passed at a meeting held at a Strand tavern on April 15, 1841, it is not surprising that with such a man at its head the infant body put down education as the first item on its programme. Before the end of the first year a course of lectures had begun at 17 Bloomsbury Square, which was then, as it is now, the Society's headquarters. The policy was initiated of securing as lecturers men of high standing in their particular branches of science, a policy which has been maintained ever since. A year later, the School of Pharmacy—now recognized as a school of the University of London—was established, and soon a chemical laboratory, the first of its kind in Great Britain and the equal of those existing at that time in Germany and France, was set up. A system of examination was instituted, and in due course there was available to physicians the services of a new class of craftsmen well equipped by training and education for the purpose of their calling.

It was not until the Pharmacy Act, 1852, was passed that statutory recognition was given to those who passed the examinations, and not until 1868 that the Society succeeded in impressing upon Parliament that the best way of protecting the public from the dangers inherent in the mishandling of poisons was to reserve the retail sale of these substances to trained vendors. Even to this day, the practice of pharmacy has never been restricted by legislation, but fortunately the law now furnishes means by which the public can distinguish a pharmacy which is under the management of a qualified person from a shop which is not so managed.

Space does not permit extended references to the valuable work done by the Society in connexion with the production of the "British Pharmacopœia", or to many of its other activities, notably its scientific meetings, directed to the spreading of knowledge among its members. The quality and advanced nature of the research work now undertaken in the College of Pharmacy is seen in recent reports from its several departments. Thus in the pharmaceutical chemistry laboratories investigations have been made with the view of bringing recent developments in our knowledge of carbohydrates into the domain of medical substances by work on specific sugars in immunological work, and promising work has been done in connexion with œstrogens. Investigations made in the Department of Nutrition have shown that the pigeon test still appears to be the least accurate of the biological methods for the determination of the vitamins. In the Department of Pharmaceutics, research work has been directed to the investigation of pharmaceutical apparatus with a view to improvement in design, particularly in respect of small-scale types. In the Department of Pharmacognosy detailed studies have been made of the flowers of the belladonna plant, and examinations have been made of Jamaican and Surinam quassia. Work done in the Department of Pharmacology comes under such headings as the assay of cortical hormone, the pharmacologically active substances liberated by adreginic nerves, the pharmacology of antipyretics of the aromatic amine series, the mechanism of porphyrin excretion, the toxicity of certain bactericides, the pharmacology of eucalyptus oil and the chemical assay of powdered ergot.

The above is but a small selection of the subjects which have occupied the attention of research workers of the Pharmaceutical Society, but it serves to show how truly it has endeavoured to fulfil the obligations placed upon it by the Royal Charter of incorporation to advance the knowledge upon which the art of pharmacy is based. It is a far cry from 1841 to 1941, when one reflects upon the state of pharmacy as it was when the Society was founded and as it is to-day. There has been, of course, a slowing down of research activities since the outbreak of war, mainly because of the reduction in staff. Prof. J. H. Gaddum, director of the Pharmacological Laboratories, undertook an appointment under the Government for the duration of the War, and other members of the Society's staff have also been called to different duties. Nevertheless, useful research work continues to be done in the several departments.

Sufficient has been said to show that the Pharmaceutical Society of Great Britain well merits the congratulations it has received not only from kindred institutions in other countries, but especially from the bodies representative of the medical profession, which recognizes that the debt it owes to pharmacy is a debt owed to the Society.

OBITUARIES

Dr. Eugene Dubois

Dr. Eugene Dubois who, exactly half a century ago, discovered in Java the fossil remains of that strange being which he regarded as transitional between ape to man and to which he gave the name *Pithecanthropus erectus*, died at his home in Haarlem, Holland, on December 16, 1940. The discovery of the most famous of missing links was announced to the world by a monograph published in Batavia in 1894 and entitled "Pithecanthropus erectus, eine Übergangsform". No single discovery in the realm of dead things has given rise to such a voluminous literature, to so many animated discussions or to so many divergent opinions. There are not so many alive now who remember the arrival of Dubois in England in the autumn of 1895, and saw with their own eyes the material evidence of man's evolutionary past which he had just brought back from Java, and took part in the debates which the discovery aroused. Right to the end of his life Dubois maintained that the being he had unearthed was neither man nor ape, but represented a stage which marks the transition from ape to man. Some of his Continental critics regarded Pithecanthropus as a gigantic gibbon; others gave the thigh bone to an extinct form of man and the skull cap to an extinct form of ape. British anatomists, on the other hand, took the view that Pithecanthropus was a hominid—an early form of man.

In 1898 Dubois again came to Great Britain, to attend the Fourth International Zoological Congress, held in Cambridge. He, the late Sir Grafton Elliot Smith and I were guests of Dr. W. L. H. Duckworth at Jesus College. By this time Dr. Dubois had succeeded in extracting from the skull cap the stony matrix which had filled it and had taken from its interior a cast reflecting the features of the Pithecanthropoid brain. A glimpse by the expert eye of Elliot Smith revealed to him features in the brain which were altogether human; it was a very early human stage which had been discovered. This verdict was confirmed by the Pithecanthropoid family unearthed in the Trinil formations of Java by Dr. Koenigswald during 1936–39[1]. There was much doubt, too, as regards the geological horizon to which Pithecanthropus should be assigned. Dubois favoured a late Pliocene date; the consensus of opinion now is that the date is early Pleistocene, which makes Pithecanthropus a contemporary of Peking man in China and of Piltdown man in England.

In 1925 I gave the following account of Dr. Dubois[2]: "If Dr. Eugene Dubois had been born in the 16th century his spirit of adventure would have found its outlet on the Spanish Main, but being added to the population of Holland in the latter half of the 19th century, when Darwinian ideas were spreading across Europe, he went in search of the 'missing link'. Having finished a training in science and in medicine at the University of Amsterdam in 1888, he became a military surgeon, choosing Java for his service. Before setting out for that island, he promised his fellow students, in all seriousness, to bring home the missing link".

This statement brought me a long letter from Dr. Dubois giving several important and desirable details relating to earlier years of his career, details which will become of increasing interest as years go by. The greater part of this letter is reproduced here in his own English:

Haarlem,
2nd April, 1925.

"Let me express my gratitude for the personal kind note on the discover of the Wadjak Man and Pithecanthropus. At the same time I beg leave to correct some personal statements.

"It was not a spirit of adventure but of scientific reasoning (see a paper in the 'Natuurkundig Tijdschrift voor Nederlandsch-Inde" of April 1888) that pithecoid human forms should be expected in pleistocene or pliocene deposits of the Malayan Archipelago, that induced me to undertake palæontological researches in that archipelago. Before I went to Sumatra (where I expected to make excavations in the many caves of the Padang high lands) in 1887, I had been, during seven years[3], Max Fürbringer's assistant and pro-sector, finally lecturer on Anatomy at the University of Amsterdam. . . . My purely scientific work had been chiefly of comparative anatomy, expecially on the larynx. . . .

"I did not promise my fellow students, in all seriousness, to bring home the 'missing link', but I did tell Prof. Max Fürbringer and Max Weber, my motives why I preferred to give up a certain and beautiful anatomical career for an uncertain one as a field paleontologist, the only way giving access to the latter being that of engaging as a military surgeon in the Neth.-Indian army.

"The paper in the 'Natuurk. Tijdschr.' and some paleontological results of excavations of caves in Sumatra, then induced the Ned.-Ind. Government to charge me officially with *paleontological researches in the pleistocene and pliocene deposits of Sumatra and Java*. From these I brought home a collection at least five times as large as that of the Selenka expedition (1906). I collected also in the Siwalik Hills.

"Pithecanthropus was not found in the 'Hell' of Java, but near that 'Hell', this being the garrison town of Ngaur, in the neighbourhood of Trinil, owing its name of 'Hell' to the circumstance that it was in former times a military convict settlement. . . . In 1898 I was appointed as professor of Geology and Paleontology at the University of Amsterdam."[4]

On returning to Europe in 1895 Dr. Dubois placed only a little of his goods in his 'shop-window'; right on to the end of his life he fetched surprise packets from his back-shop. In 1920 he produced the Wadjak fossil skulls, although he had found them before Pithecanthropus came to light. It was the publication of a description of a fossil skull found in Australia that made him release the Wadjak specimens—which also had Australoid characters. In 1924 he at last published excellent illustrations of the brain cast of Pithecanthropus and also produced a piece of a fossil mandible which he had found in 1890 and now attributed to Pithecanthropus. In 1932 he produced fragments of three more thigh bones of Pithecanthropus.

The cemetery of fossil man which was discovered and exploited by Dr. Dubois in Java has proved to be rich beyond any other in every respect—rich in actual numbers and in types which preserve details of the sequence of humanity that has flitted across the time stage of Java these million of years past. The series begins as ape-men and ends in the aboriginal type of modern Australia. Only in this Australo-Malayan part of the world is the evolutionary history of man known with any degree of fullness[5], and for this we are chiefly indebted to Dr. Eugene Dubois.

A. Keith.

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[1] See Nature, 144, 926 (1939).

[2] "Antiquity of Man", Second Edition, p. 438.

[3] Dr. Dubois was above medium stature, and although full-bodied, carried himself rather rigidly erect. When in England in 1895 he seemed to be under thirty years of age; from the above statement one infers he must have been born about 1858.

[4] This letter, although it contains further interesting details, is too long to give in full; the original is to be added to the library of the Royal College of Surgeons, (London, W.C.2).

[5] See Keith, Nature, 138, 277 (1936).

Sir Hugh Murray, C.I.E., C.B.E.

Sir Hugh Murray died at Nunton Cottage, Bodenham, Salisbury, on February 9. For more than fifty years Hugh Murray was connected with and played an active part in the development of forestry and forestry administration in India and Great Britain; both Bombay and England will long remember him and his delightful personality. Murray was born on April 27, 1861. He was educated at Trent College and took his forestry training on the Continent. He joined the Indian Forest Service in 1882, being appointed to the Bombay Presidency.

As a district forest officer, Murray acquired the reputation of being a hard-working and tactful officer, and this recognition was fully maintained when he reached administrative rank in the Presidency. During the twenty-nine years of his service there were some very difficult forestry problems bearing upon the habits and customs of the agricultural population in Bombay which came up for, if not solution, at any rate settlement for the time being. As he rose in seniority Murray was able to give valuable advice in this direction; especially when he occupied the position of Senior Conservator in the Presidency and Additional Member of the Provincial Legislature. He retired from the Indian Service in 1911.

Soon after the outbreak of the War of 1914–1918, Murray was called into the War Office to advise on the then urgent and totally new question of obtaining timber supplies under war conditions. For three years he was thus occupied, becoming deputy controller of timber supplies in 1917.

The Forestry Commission was inaugurated in 1920 as a result of the Parliamentary Bill of 1919. A number of commissioners were appointed, and a technical assistant commissioner for England and Wales and a second for Scotland. Murray was appointed to the English post, and a better choice at that time could probably not have been made, for senior trained foresters with ripe administrative experience were few in number. His chief work was connected with the acquisition of land for the new State forests, and in this he displayed great ability. He was equally interested in the planting work then being started on a large scale and in the research inaugurated at this period. After four years Murray was appointed a forestry commissioner, thereby strengthening the technical position of the Commission. He remained a commissioner until 1934, when he finally retired.

He married, first, Gwendoline Mabel Langridge and had a son; and secondly, Dorothy Christine, daughter of the Right Hon. Sir William Mather, and had a son and daughter. E. P. Stebbing.

Mr. J. Picken

Mr. James Picken, one of the alkali inspectors in the service of the Ministry of Health, died suddenly on February 17, aged forty-six. After a period of service with the Royal Garrison Artillery in France, Mr. Picken took his degree at the University of Glasgow, and was afterwards for some years in charge of the Glasgow Corporation's chemical works at Dawsholme and Provan. He received his appointment as one of H.M. inspectors of alkali works in 1924, and from that time had been in charge of the Sheffield district, where his unfailing tact and courtesy, together with the efficient but sympathetic manner in which he carried out his duties, had earned him the respect and affection of all with whom he came into contact.

We regret to announce the following deaths:

Dr. Annie J. Cannon, assistant in the Harvard College Observatory during 1897–1911, and curator of astronomical photographs since 1911, aged seventy-seven.

Dr. David Forsyth, an authority on the diseases of children, on April 10, aged sixty-three.

Sir Nigel Gresley, chief mechanical engineer of the London and North-Eastern Railway, on April 5, aged seventy-six.

Prof. K. N. Konstantinovich, director of the Moscow Institute of Experimental Biology and formerly director of the Central Station of Genetics, aged sixty-nine.

Mr. J. C-S. McDouall, O.B.E., formerly director of Medical Sanitary Services, Sierra Leone, on March 25.

Prof. Carlos G. Malbran, professor of bacteriology in the University of Buenos Aires.

Sir Albert Seward, F.R.S., professor of botany in the University of Cambridge during 1906–36, on April 11, aged seventy-seven.

Prof. Roy B. Smith, emeritus professor of chemistry in Colgate University, aged sixty-five.

NEWS AND VIEWS

Prof. Frank Schlesinger

Prof. Frank Schlesinger, who is shortly retiring from the directorship of the Yale University Observatory, is the doyen of American astronomers. His work has been concerned mainly with astrometry, and has been characterized by originality, economy of effort and high precision. As director of the Allegheny Observatory, he used the 30-inch Thaw refractor for the determination of stellar parallaxes. From a masterly discussion of the observations and of the various sources of error, he laid down the methods to be followed to ensure the greatest attainable accuracy. These methods have been adopted at other observatories and have led during the past quarter of a century to a great development in the knowledge of stellar distances. After Schlesinger's appointment as director of the Yale University Observatory, he decided to erect a 26-inch refractor in South Africa to determine the distances of southern stars. This telescope was erected in the grounds of the University of the Witwatersrand, Johannesburg, for this specific programme; and for economy in cost, it is mounted in a meridian building, which restricts its movement to a few degrees on either side of the meridian. Intensive observations with this telescope, in conjunction with those at the Cape Observatory, have made the knowledge of the distances of southern stars almost as complete as for northern stars.

Schlesinger has also been the pioneer in the determination of stellar positions with wide-angle lenses, covering fields up to 100 square degrees, in contrast to the 4 square degrees of the Carte-du-Ciel plates. This has enabled visual observations with meridian instruments to be restricted to the brighter stars and effects a great economy in time in photography at the telescope. Methods of measurement and reduction have been carefully planned to secure the greatest economy of effort. Photographs taken with a camera attached to the telescope at Johannesburg have been measured and reduced in New Haven and, with only a small staff, star catalogues have been produced at a surprising rate. Two compilations, the "Catalogue of Stellar Parallaxes", in which all determinations have been combined with appropriate weights and their systematic errors investigated, and the "Bright Star Catalogue", have proved invaluable for reference purposes. Prof. Schlesinger's sound judgment, sane outlook and wise counsel have given him an outstanding position not only among American men of science but also in international astronomy, and were fittingly recognized by his election as president for 1934–35 of the International Astronomical Union.

Honorary Degrees at Bristol

In his capacity of Chancellor of the University of Bristol, Mr. Winston Churchill attended a Congregation on April 12 for the conferment of the honorary degree of Doctor of Laws on Mr. John G. Winant, the American Ambassador, Mr. Menzies, Prime Minister of Australia, and (in absence) on Dr. J. B. Conant, president of Harvard University. Referring to the honorary graduates, Mr. Churchill said: "Through him [Mr. Winant] and other distinguished representatives who are with us to-day . . . we make another tie with the illustrious President of the United States, and with the representatives of that vast community at a time when great matters of consequence to all the world are being resolved. . . . In Dr. Conant we have a figure, widely and deeply respected throughout the United States, and particularly among the youth who attend Harvard University, holding up a clear beacon light for young men of honour and courage." Mr. Menzies, he said, has brought with him the strong assurance of the democracy of the Commonwealth that they with us will go through this long, fierce, dire struggle to the bitter end.

Speaking of the occasion as one of rare and exceptional character because the visitors to whom they were showing honours and courtesies are playing an important part in the universal drama which is unfolding, Mr. Churchill said, "Here we gather in academic robes and go through ceremonials and repeat formulas—here in battered Bristol, with the scars of new attacks upon it. Many of those here to-day have been all night at their posts and all have been under the fire of the enemy, under heavy and protracted bombardment. That you should gather in this way is a mark of fortitude and phlegm, of a courage and detachment from material affairs worthy of all that we have learned to believe of ancient Rome or of modern Greece."

Yugoslav Fauna and Flora

The extension of war into Yugoslav territory takes it into an area of the south-eastern Europe fauna and flora which had only begun to be properly explored by biologists within modern times. The British Museum expedition of 1937 collected four species of Clitellus (susliks or gophers) in Yugoslavia (*Annals and Mag. of Nat. Hist.*, May 1940), two of which were new to science, *Clitellus c. karamani* (named in honour of Dr. Stanka Karaman, explorer of Macedonian fauna), from Karadjica Mountains, Macedonia, and *Clitellus c. laskeri* (named after Prof. V. Laskarer, of the University of Belgrade). Slovenia contains abundant chamois, red and roe deer, bear, wild boar and even lynx, while its avi-fauna includes capercaillie and stone partridge, mostly protected by the 1931 game laws. Spoonbills nest abundantly on the Obekska Bara bird reservation near Belgrade. In the Knez Mihaileva region buzzards and eagles are still well established, while magpies and jays from the Belgrade suburbs have frequently been observed passing over the city.

Flights of wild geese and wild duck, the former coming from the great Hungarian marshes, are frequent sights at the time of hunter's moon. Insect life includes a wealth of butterflies and the curious Yugoslav tiger moth, *Cymbaciophora pudica*, which produces a loud squeaking or clattering noise by its wings in flight. The caves of Dalmatia and Carinthia have long interested naturalists for their blind olm or cave newt, *Proteus anguineus*. The flora is rich in alpine flowers of great beauty. Pančic wrote a useful "Flora of Serbia", and recently Hayek compiled a new Balkan flora. It is an irony that one of its most recent students was Dr. Giuseppi, the Italian botanist and member of the Alpine Club. On his 1930 visit he found *Geranium subcaulescens* on Mount Koprevnia and *Saxifraga montegrina*, receiving the award of merit of the Royal Horticultural Society when introducing the former to British gardens. On Mount Cristen he found *Ranunculus creatus*, and in 1931 on Kerast he found *R. Wettsteisii* and *Ardrosance Hedreantha*, on Ljuetia, *Viola Grisebachiana*. W. B. Turrill, of Kew, also studied the Balkan flora during the War of 1914–18 and three times since. Good herbaria existed at Belgrade, Sofia and Trieste. Tournefort, Sibthorp, Clark, D'Urville and Grisebach collected in the area, which has a flora of some 6,500 species.

International Relations and Federalism

THE February 1941 issue of *Union*, the monthly forum of the New Commonwealth Society, includes a number of articles on post-war reconstruction and the development of international relations. Mr. Duncan Hall, in an address on "What are the hopes of Lasting Peace ?" asserts that only by a scientific understanding of the dynamic forces of human nature and human society, by a realistic education and a wise leadership, can we hope to speed up man's progress towards a lasting peace, based on the supremacy of reason and conscience. The problem is far more than one of finding the right institutions and making economic adjustments. It is essentially a problem of how to control the human forces, how to prevent uneven domestication, how to safeguard against mob situations that break down the conscience and reason of the individual and let loose his instinctive forces. Writing on "The Outline of a Long-Term Economic Plan", Mr. W. L. Fairweather urges that the task ahead of us is to raise the level of consumption all over the world, and that many of the controls necessary in war will be extended and developed and remain as a permanent feature of the economic system. Mr. Channing-Pearce's address to the Oxford Branch of Federal Union on January 4 on "The Federal Faith" is included, with its conception of federation as concerned not only with politics but also with sociology and economics.

The Wilkes Centenary

THE centenary of the Wilkes Exploring Expedition of the United States Navy, 1838–1842, was marked by a symposium on American polar exploration organized by the American Philosophical Society in February of last year. The papers read on that occasion are now published (*Proc. American Phil. Soc.*, **82**, No. 5) and include some valuable contributions to polar geography. The expedition is best remembered for its antarctic landfalls, which have since been the subject of much controversy but mainly have been confirmed. The expedition had, however, a practical bias, actuated by the considerable American whaling industry in the Pacific at that time, and the scientific side was not too strong though valuable results were obtained not only in the antarctic but also in many surveys in Pacific islands and numerous biological collections. The greater part of the results were published by the authority of Congress, but the edition was small and many of the volumes are rare. In the present publication the history of the expedition and the story of the struggle to get the reports published are fully traced and there are valuable bibliographical records.

A most useful paper deals fully with the fishes collected by the expedition, a report which has not previously appeared. This is by Mr. H. W. Fowler. Another paper, by Commander F. W. Reichelder, discusses the contributions of the expedition to magnetism, gravity and meteorology. Prof. W. M. Hobbs treats of the geographical discoveries. Another series of papers deals with other aspects of American polar work. Of these may be noted one by Mr. W. E. Ekblaw on the arctic discoveries of De Haven, Kane and Hall and another by Mr. H. J. Lee on Peary's journeys in North Greenland. Two valuable and original papers are those by Prof. L. M. Could on the glaciers of Antarctica, which surveys all the glaciological problems, and one by Mr. V. Stefansson in which, with his customary bold conception, he advocates a ten-year programme of arctic studies to be centred in a number of stations, most of them on the pack-ice, to be established and maintained by air.

Early Man in Virginia

FOR some little time evidence has been accumulating which points to Bedford County, in south-western Virginia, as a place of early settlement of stone-using aboriginal tribes of nomadic hunters. During proto-historic and early historic times, Siouian and Iroquoian tribes appear to have lived within the present bounds of the county ; while the Cherokee in the earlier half of the nineteenth century still retained the memory of an old tradition that a Cherokee village once stood near the twin Peaks of Otter in the north-west of the county where it is crossed by the Blue Ridge. These peaks were formerly thought to be possibly among the highest of the northern continent ; and it is believed that the region around had been occupied for many centuries by a succession of tribes of different stocks, ever since the time when nomadic bands first entered the wilderness. This belief has now received the support of recent discovery in the form of stone implements of an early type on a site, now known as the Mons site, which was revealed early in 1940 in road-making operations in the vicinity of the Peaks of Otter. In a description of the site and finds by David I.

Bushnell, jun. (*Smithsonian Miscell. Collect.*, **99**, 15; 1940) it is recorded that stone artefacts, fragments of steatite vessels and small bits of earthenware were exposed during removal of the top soil. Although some specimens were obviously older than others, no determination of age was possible in the absence of stratification. Nor was it possible to mark the extent of the settlement; but quantities of flakes of various types and fractured pebbles indicated the existence of a workshop. The types of artefact included flake-knives and scrapers, projectile points, several forms of edged implements, axe-like implements, hammerstones and possibly pestles. Two Folsom points have been found on the site mingled with the other material.

This is the first occasion, so far as is known, on which the Folsom point has been found in the eastern States in association with other material or on a settlement site, though Folsom points of the Eastern type, which is not identical in all details with that of the south-western States, have been found sporadically in Virginia and elsewhere. The specimens from the Mons site may be regarded as clinching the argument for an eastward extension of Folsom man associated with an evolving industry, conditioned at times by the necessary employment of a refractory material. That the nature of the stone and not ignorance of the characteristic technique is responsible for the absence of the groove in the chert points from the Mons site is shown by the occurrence there of flakes of jasper, such as would be produced in the manufacture of a typical point of that material, which has been found no more than two miles away.

Agricultural System of the Argentine

THE Imperial Bureau of Pastures and Forage Crops, Aberystwyth, has recently published a bulletin on "The Grasslands of the Argentine and Patagonia" (*Bull.* 30. 2*s.* 9*d.*). The author, W. Davis, has himself made an extensive tour of South America, and his account contains much of interest to the general reader as well as to the grassland specialist. Patagonia is chiefly a sheep ranching country, carrying a vegetation of open tussock grassland in the south, and shrub steppe in the central and northern regions. In the Argentine proper, cattle are more important than sheep and, compared with Patagonia, farming is much more intensive. As a result, the native flora has been largely replaced by exotic species of both grasses and legumes.

One of the most interesting features of this intensive farming is the practice of fattening cattle on lucerne in the La Plata region. The temporary ley is the basis of this form of husbandry, together with the use of cereal crops for out-of-season grazing. Much of the land is held by companies and by individuals who are fattening cattle on large holdings (*Estancias*), and is worked on a share farming system. The farmer cultivates and crops the land, sharing the crop with the landowner on an agreed basis. After a run of cereal crops, it is a condition that the land must be laid down to lucerne, at which juncture the farmer moves on to another holding, and the owner receives his land back carrying the requisite crop for his cattle. It is suggested that a modification of this system might profitably be used in parts of Great Britain. The bulletin concludes with an interesting account of the *frigorifico* at Buenos Aires, where killing of the cattle and utilization of every part of the carcasses are carried out in a most efficient manner.

The Nigerian Forester

THE idea of issuing a journal in Nigeria or for West Africa generally on the lines of the *Indian Forester* was mooted several years ago. Last year saw a realization when two numbers of the *Nigerian Forester* were published in July and November. The editor appears to be somewhat diffident about the appearance of a new publication in war-time. The paper devoted to its publication, however, is very far from being wasted, for some of the articles appearing in the first number are both timely and of interest. With one exception, where the exotic trees of the Cameroons are dealt with by D. R. Rosevear, the articles in the first number deal with either Northern or Southern Nigeria and present a wide variety of problems. In the second number, in addition to some general articles such as "Termites and Soil Fertility", "Work in the Veterinary Department, Nigeria", and "Some Applications of Grassland Ecology", subjects such as "The Gold Coast Timber Industry" and "First Impressions of Forestry in Sierra Leone" are dealt with.

Perhaps of wider interest, though somewhat sad, is the announcement that the *Nigerian Forester* is to be replaced by another publication on the same lines but with a wider purview, entitled *Farm and Forest*. This publication will be devoted to the discussion of land use problems in West Africa from the point of view not only of the forester but also of agricultural, veterinary and other workers interested in the manifold aspects of rural economy. It will thus have a wider public and should get over the financial difficulty which a specialized journal issued by a small Government Department always has to face.

Underground Gasification of Coal in the U.S.S.R.

THE "Russia Today" Press Service has issued a statement of the progress of work on this problem during the last few years in the U.S.S.R. It is recalled that Mendeléeff envisaged this method of fuel treatment, and about a generation ago Sir William Ramsay suggested the initiation of research thereon in Great Britain. In the U.S.S.R., however, the first practical work was begun in 1933 on the gasification of the coal in the seam. This is reached by two shafts connected by a tunnel cut through the seam itself. The coal is gasified by a blast of air or oxygen and steam blown down one shaft while the hot gas produced is collected from the up-cast shaft. This method necessitates the labour of miners to sink the shafts and to tunnel the seam before gasification can begin. In a new installation in the Donetz coalfield, the seam will be reached by bore holes so that no underground work will be necessary. Last

November a plant, it is said, started operation on an industrial scale in the Moscow coal area to supply gas for chemical manufacture. A new installation in the Donetz coal field is expected to dispense with the services of five hundred miners. Where oxygen is employed to enrich the blast and so produce a gas of higher calorific value and lower nitrogen content, the cost of the separation of oxygen from air largely determines the economics of the process. It is claimed that Prof. P. L. Kapitza has designed a plant for air separation which marks an advance in technical efficiency.

At a time like the present, it is important to picture the possible consequences of these developments. If successful, they would mean the reduction or abolition of one of the most arduous of human efforts, but only if coke could be dispensed with. Coal, once gasified and converted into a mixture of carbon monoxide and hydrogen, becomes not merely a flexible source of heat and power, but also a starting point for the most diverse chemical syntheses. In a highly industrialized country like Great Britain, it would cause the grave problems of unemployment inevitable when remodelling the structure of industry. We need not be unduly timid about this because it will take a long time to surmount the technical and economic obstacles. It does, however, stimulate the spirit of curiosity and the will to look ahead which is often lacking in our old-established industries.

Factory Lighting in Wartime

In the Engineering Supplement to the *Siemens Magazine* of February 1941, there is an instructive article by Mr. C. J. Misselbrook on "Factory Lighting in War Time". The fifth report of the Departmental Committee on Lighting in Factories issued in June 1940 has given a number of important recommendations on this subject and indicates a minimum standard which, although it would have been regarded a few years ago as unnecessarily lavish, is now in accordance with all good modern lighting practice. The recommendations of the report may be divided into two sections, adequacy and suitability, each of which presents its own problems. War conditions have resulted in the introduction of unskilled or semi-skilled workers into the industrial world and the work of training them is greatly facilitated if they are not expected to strain their eyes on unfamiliar tasks with inefficient lighting. In addition, the calling up of young men and their replacement by older workers increases the need for good lighting, for as a rule the eyes of older people are not so efficient as those of the younger generation, and consequently need more light for the equivalent 'seeing conditions'.

As regards adequacy, the report recommends a minimum illumination of six foot candles without prejudice to any additional illumination required by the nature of the work. This is a large increase on the one foot candle which was considered satisfactory when the last report was published about three years ago, but is easily obtainable with modern high-efficiency light sources. The question of providing illumination raises also the question of the amount of heat produced, which is sometimes excessive and gives rise to uncomfortable working conditions. The lighting specialist can often reduce the amount of heat by using an alternative type of lamp. For example, the 'Sieray' fluorescent tube is a good alternative to the 200-watt gas-filled lamp giving approximately the same amount of light but operating at a much lower temperature. There are many instances where the type and standard of work require a higher intensity of illumination than can normally be provided by general lighting. If this is provided by local lighting, all such points should be fitted with opaque shades, as an imperfectly screened lamp is a very frequent source of glare, leading to eye-strain and sometimes to accidents. With regard to wiring, the question arises when raising the standard of illumination, whether it is more economical to employ electric discharge lamps with their higher initial cost or to rewire the building. Sieray lamps have often proved of great value in such cases, as they can be readily interchanged with tungsten filament lamps with no alteration in the existing wiring.

Royal Geographical Society Awards

The King has approved the award of the Royal Medals of the Royal Geographical Society as follows: *Founder's Medal:* Captain P. A. Clayton, for his surveys in the Libyan Desert and his application of this experience to desert warfare during recent operations; *Patron's Medal:* Dr. Isaiah Bowman, president of Johns Hopkins University, Baltimore, for his travels in South America and for his great services to the science of geography while director of the American Geographical Society of New York. The Council of the Society has made the following awards: *Murchison Grant:* Mr. C. T. Madigan, for his explorations and research in Central Australia; *Back Grant:* Mr. Alfred Stephenson, for his surveys in south-east Greenland and in Graham Land; *Cuthbert Peek Grant:* Mr. Marcel Aurousseau, for his valuable services as secretary of the Permanent Committee on Geographical Names; *Gill Memorial:* Captain F. Spencer Chapman, for his exploration of high peaks in Sikkim and Tibet.

Announcements

Prof. W. W. C. Topley, F.R.S., professor of bacteriology and immunology in the University of London, has been appointed secretary of the Agricultural Research Council in succession to Sir Edwin Butler, F.R.S., who has retired on account of ill-health.

On April 8 an earthquake shock was felt in western Japan. Surface faulting took place, which damaged a railway track, causing goods trains to be derailed. No casualties have been reported. On April 9 a strong earthquake was felt at Terni in central Italy. This was followed by a strong aftershock. Neither shock caused damage.

LETTERS TO THE EDITORS

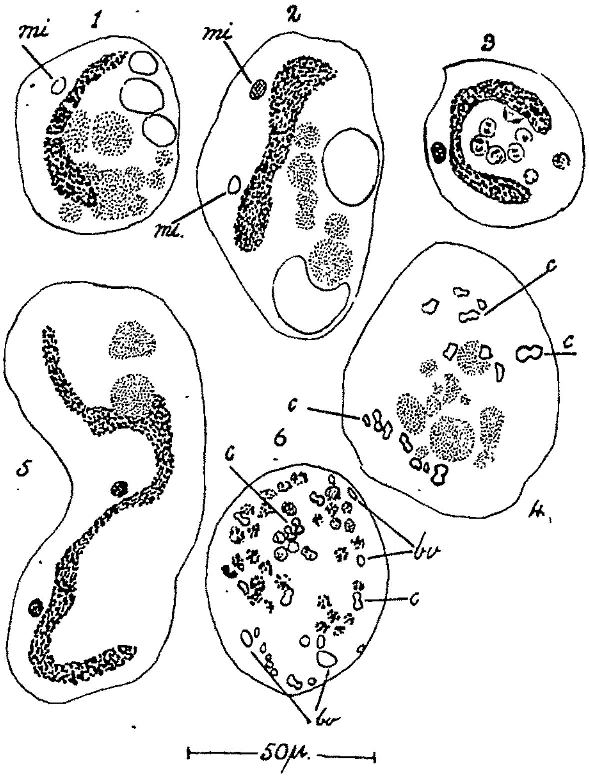
The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Virus Inclusions, Blastogenic Agents and Ciliates

THERE was reported in these columns[1] the production of abnormal Paramecia by 3 : 4-benzpyrene, and the information that these abnormal cells, by reproduction, gave rise, in the absence of the agent and indefinitely, to abnormal races showing widely varying polymorphism, like the cells of tumours.

Since then, similar races of abnormal Paramecia and other Ciliates have been produced by suitable exposure to the following blastogenic agents: cyclic hydrocarbons, gamma and ultra-violet radiations, heat, cold and hypertonic dextrose.



NOS. 1, 2 AND 5 ARE SPECIMENS FROM THE INFECTED CULTURE STAINED BY FEULGEN'S METHOD; THE NUMBER OF PARTICLES PER UNIT AREA IS APPROXIMATELY CORRECT; IN NO. 1 THE MICRO-NUCLEUS (*mi*) IS UNSTAINED; IN NO. 2, WHICH IS A DOUBLE, ONE IS UNSTAINED AND THE OTHER FAINTLY STAINED; NO. 5 IS A DOUBLE-MONSTER; NO. 3 IS A NORMAL WELL-FED ORGANISM STAINED FEULGEN; NO. 4 IS AN INFECTED CELL STAINED GRAM AFTER FORMALIN VAPOUR FIXATION, IT SHOWS INCLUSION BODIES AND DUMBELL CRYSTALS (*c*); NO. 6 IS A NORMAL STAINED INTRA VITAM WITH CRESYL BLUE, IT SHOWS FOOD VACUOLES, CRYSTALS AND BLUE VACUOLES (*bv*).

The possibility that a virus might be playing a part has been kept in mind; nothing suspicious was noted until a few weeks ago. In a culture of Aspidisca sp. subjected to 40° C. for one minute, abnormals were sought for; they occur for 24–48 hours after such an exposure. None was found, as is often the case, since they are always of rare occurrence. In the culture, six days later, I was astonished to see many abnormals, far more numerous than ever seen before. Some were picked out and stained by Feulgen's method; they showed in the cytoplasm, collections of minute stained particles, similar to virus inclusions (see accompanying figure).

These inclusions are easily distinguished from food vacuoles containing bacterial debris shown in Nos. 3 and 6. It may be mentioned that organisms fed on Gram positive Staphylococci do not show Gram positive cocci in the food vacuoles: they become Gram negative. The inclusions appear to lie free in the cytoplasm and not within a vacuole. They have never before been found in Aspidisca, either in normals or in abnormals produced by blastogenic agents.

The infected culture was sub-cultured to many well slides, under conditions known to favour abundant growth. Instead of reproducing, they ceased to divide and gradually died out, all being dead on the twenty-second day. Many attempts to infect normals and cells subjected to blastogenic agents were unsuccessful.

Two other facts are worth recording. Accompanying the presence of abnormals in the infected culture, were seen all the signs of increased cytoplasmic viscosity which has invariably been observed preceding the production of abnormals by blastogenic agents. There is, therefore, a similarity in the reaction of the cells to virus and to blastogenic agent. I also noted that in many cases, the micro-nuclei failed to be stained by Feulgen, see Nos. 1 and 2; perhaps the supply of nucleic acid to the micro-nuclei is interfered with, being all grabbed by the virus; in these specimens one also sees unstained bands, see No. 1, in the macro-nucleus as though it, too, was deprived of nucleic acid.

I would be very grateful for any information on virus or virus-like inclusions in the Protozoa.

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March 3.

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[1] NATURE, 145, 184 (1940).

Palæochemistry of the Ocean

A quantitative account of oceanic palæochemistry depends largely on the theory accepted for the origin of the ocean, especially for its halogen content. Yet with any tenable view, useful limits for biological consideration can be established for such quantities as the total salinity at the beginning of the Cambrian period. The K/Na ratio of the original ocean can also be stated with some confidence, when we consider that the mean composition of igneous rock has not appreciably changed over the oceanic age.

The original K/Na ratio of the ocean. The speculations of Macallum[1] on the origins of the cellular potassium, and the vogue they have obtained, makes this question of some interest to the biologist. According to Macallum, potassium was more concentrated than sodium in the primitive ocean (the K/Na ratio being about 2·0) and the cell to-day with more potassium than sodium tends to repeat in an altered environment a primitive adaptation. As evidence for the higher potassium concentration he cites analyses of Reindeer Lake and Churchill River[2] situated in the zone of Archæan rock in Canada. Against this there is the Ottawa River[3], in a region of similar rock with a K/Na ratio less than unity (0·64). The Hayes and Nelson Rivers[4], draining wide areas of Archæan as well as later sedimentary strata, have a K/Na ratio of 0·32 and 0·16, which are *less* than the total river average of 0·37[5]; and the Mahanuddy, which in India drains a wide area of Archæan rock, has a K/Na ratio of only 0·28[6].

Occasionally, high K/Na ratios may be found in rivers and lakes not associated with crystalline or Archæan rock, for example, in the Würmsee and Königsee[7] (Macallum cites such as evidence for his view when it is clearly against it); and the potash lakes of Nebraska[8] occur, too, in regions where there is no outcropping of igneous or Archæan formations.

At the same time there is no apparent reason why potassium should be higher than sodium in the early seas, since the K/Na ratio in igneous rock is 0·92, and whether we consider the action of neutral or very weakly acidic rain, or of hydrochloric acid, potassium is not more readily dissolved from the rock than sodium. It is dissolved less readily. This may be proved from Merrill's studies[9] of rock weathering, from the mean analyses of rivers draining igneous rock, and from Taylor's laboratory experiments[10] with hydrochloric acid.

Occasional high K/Na values are simply explained by a *local* preponderance in the rock of potassium compounds such as orthoclase, leucite, or biotite.

Oceanic salinity at the beginning of the Cambrian period. Whether we suppose the oceanic chloride to have been present almost entirely in the original atmosphere of a cooling earth, or to have originated as meteoritic chloride of iron, or again to have condensed along with the water of the ocean from volcanic emissions, the total ionic content will not change greatly, if at all, from its value at the outset. Only on one theory of the origin of the ocean, in which the chloride, but not the water, has been entirely supplied from volcanoes, does it alter from something like lake water to its present composition.

With such a theory and a consideration of the relevant data it may be shown that the salinity at the beginning of the Cambrian age was about 1·6–2·0 per cent. In this estimate account is taken of the changing relation of igneous to sedimentary surface, of the different proportions of sodium to sediment in water draining igneous and sedimentary rock; and it is also assumed that the total depth of the pre-Cambian strata is 40 per cent of the whole sedimentary depth, which would appear to represent approximately the current view. Even if we reduced the figure to 25 per cent the salinity at the beginning of the Cambrian period would still be 1·2–1·6 per cent. Equating, therefore, the salinity of mammalian blood (about 0·9 per cent) with that of the Cambrian ocean, in which Protovertebrates may have first appeared, is a speculation not supported by the geochemical data. This, however, does not militate against the view that the ratios of the inorganic ion concentrations in mammalian plasma may have broadly an oceanic significance (Bunge[11]; Quinton[12]).

A more detailed consideration of such questions will be submitted to the Royal Irish Academy.

E. J. Conway.

University College,
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March 7.

[1] Macallum, A. B., *Physiol. Rev.*, **6**, 316 (1926).

[2] Adams, F. D., Report Geol. Survey of Canada, 9 *C.* (1878); Report Geol. Survey of Canada, 6 *H.* (1880–82).

[3] Report Geol. Survey of Canada, 565 (1863).

[4] Dittmar, W., Report Geol. Survey of Canada, 77 *C.* (1879–80).

[5] Clarke, F. W., "Data of Geochemistry", Bull. 770 U.S. Geol. Survey, 119 (1924).

[6] Nicholson, E., *J. Chem. Soc.*, **26**, 229 (1873).

[7] Clarke, F. W., "Data of Geochemistry", Bull. 770, U.S. Geol. Survey, 100 (1924).

[8] Erickson, E. T., Bull. U.S. Geol. Survey, No. 715, 133 (1921).

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[11] Bunge, G., "Lehrbuch der physiologischen und pathologischen Chemie", Leipzig (1889).

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Control of the Kromnek (Spotted Wilt) Disease of Tomatoes

In many seasons the kromnek disease causes heavy losses in both tobacco and tomato in the Cape Province and Transvaal. Its virus origin was first diagnosed[1] in the Kat River area of the eastern Cape Province, and it has since been identified with the spotted wilt disease now well known in many parts of the world. In the Kat River area it is transmitted mainly, if not entirely, by the feeding of a thrips (*Frankliniella schultzei* Trybom) which has a wide host range among both wild and cultivated plants.[2] The virus likewise attacks a very great variety of plants[3] and the control of the disease is therefore a very difficult problem which has not so far been solved for South Africa.

Tartar emetic is used effectively against the citrus thrips in America, and preliminary trials with it at this laboratory have given very promising results with regard to the control of kromnek in tomatoes. The formula used was the same as that advised for citrus thrips, namely, 1 lb. tartar emetic plus 2 lb. sugar to 100 gallons of water. Spraying was started in the outdoor seed-bed in October when the seedlings were still in the cotyledonary stage and were already being attacked by the disease vector; it was repeated frequently during the subsequent nine weeks. Control beds a few yards away were left unsprayed;

at a height of four inches they developed the symptoms of kromnek and became 100 per cent infected, growth immediately coming to a standstill. An outstanding contrast was offered by the sprayed beds, which showed vigorous healthy growth, not more than 5 per cent of the plants becoming diseased. Those left in the beds after thinning yielded a bountiful crop.

Spraying of transplanted tomatoes gave promising results, in view of the very small scale of the tests and of the consequent continuous invasion of insects from the unsprayed rows to the trial rows adjoining.

E. S. MOORE.

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Feb. 13.

[1] Moore, E. S., Science Bull. 123, Dept. Agric. Union of South Africa (1933).

[2] Moore, E. S., and Anderssen, E. E., Science Bull. 182, Dept. Agric. Union of South Africa (1939).

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Inactivation of the Causative Agent of Fowl-Leukosis by X-Rays

THE following is a report on the inactivation of the causative agent of fowl leucosis (hæmacytoblastosis, Strain *T* Engelbreth-Holm) by means of X-rays.

The method used was as follows: blood was withdrawn from the animal at the height of the infection, with the addition of sodium citrate. A drop of this blood was placed on a concave slide, covered with a mica coverslip 0·03 mm. thick and made air-tight with paraffin. Blood drops mounted in this way were irradiated. After irradiation every drop was diluted with 2 c.c. of Ringer's solution, and 1 c.c. of the diluted blood was inoculated intravenously into a fowl. Altogether six series of experiments were carried out on thirty-four fowls. Control experiments were made for each series with non-irradiated blood.

Irradiation was carried out by means of a demountable X-ray tube with copper anode operated on a vacuum pump at a tension of 35 kv. and a current of 30 ma. The intensity of the X-rays was about 105,000 r./min. at the distance of the irradiated subject. According to absorption analysis the overwhelming part of the radiation used consisted in characteristic *K*-rays of the anode material (copper). The half-value layer in aluminium was 0·053 mm. The results are given in the accompanying table.

Leucotic virus is destroyed with certainty by a dose of 4,000,000 r.; 2,000,000 r. has no effect. When 3,000,000 r. is used results vary. We obtained three negative results against two takes; both the latter showed an anæmic form of hæmacytoblastosis.

X-ray dose in million r.	No. of chicks injected	Successful injections	Unsuccessful injections
½	2	2	0
1	2	2	0
2*	4	4	0
3	5	2*	3
4	11	0	11
5	6	0	6
6	4	0	4

* Anæmic forms.

The doses used by us for inactivating the agent of fowl leukosis lie in the same range as those used for inactivating the few viruses of which the resistance to irradiation has been determined. The inactivating dose for fowl plague virus is 3,000,000 r. (Levin and Lominski[1]), for infectious papilloma of the rabbit 3,000,000 r. (Lacassagne and Nyke[2]), for vaccinia somewhat more than 3,900,000 r. (Gowen and Lucas[3]). The doses used by us for inactivation are many times larger than those employed hitherto in attempts to influence the leucotic agent, and this is undoubtedly the reason for the negative results obtained by Engelbreth-Holm and Rothe-Meyer[4], by Forfota[5] and by Jarmai[6].

This work has been aided by a grant from the Lady Tata Memorial Trust.

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Hebrew University,
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Feb. 2.

[1] Levin, B., and Lominski, I., *C.R.*, **203**, 350 (1936).

[2] Lacassagne, A., and Nyke, W., *C.R. Soc. Biol.*, **128**, 1038 (1938).

[3] Gowen, J. W., and Lucas, A. M., *Science*, **90**, 621 (1939).

[4] Engelbreth-Holm, J., and Rothe-Meyer, A., *Acta path. et microbiol. scand.*, **9**, 293 (1932).

[5] Forfota, E., *Strahlenther.*, **59**, 83 (1937).

[6] Jarmai, K., *Arch. wiss. u. prakt. Tierheilk.*, **74**, 67 (1939).

Diffuse X-Ray Reflexions

FOLLOWING the observation by Sir William Bragg that diffuse scattering takes the form which it should have if it were due to diffraction by small groups of atoms within a crystal (as originally suggested by Preston), Prof. G. E. M. Jauncey[1] has obtained a formula giving the resulting positions of the diffuse spots for small values of $(i - i_B)$, i being the glancing angle of incidence on the set of crystal planes for which i_B is the Bragg angle. He expresses astonishment that this formula is identical with those deduced by Zachariasen and by Raman and Nath, each on very different assumptions. Mr. G. D. Preston[2] has pointed out that this formula is an approximation to the formula given by Faxén in 1923, and stated that the physical interpretation of Faxén's formula is that the surfaces of constant intensity surrounding the Bragg points are spheres. This, however, is again *only true when* $(i - i_B)$ *is small.*

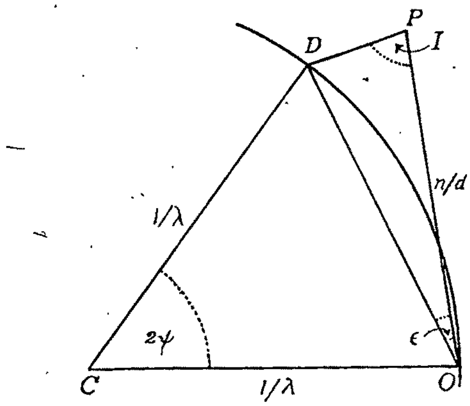
The reason why all these different assumptions (for example, existence of small groups, waves of the Raman type or elastic heat waves) give the same formula for small values of $(i - i_B)$ is that in the derivation of each formula it is implicitly or explicitly assumed that the spreading of the intensity of reflecting power around each reciprocal lattice point is independent of direction. Consequently, the formulæ are simply a geometrical way of expressing the fact that *near* the reciprocal lattice points the distribution may be taken as spherical.

Raman and Nath's more general formula

$$d \sin \psi \sin (I - \varepsilon) = n\lambda \sin I$$

is also only a *purely geometrical relationship* connecting the centre C of a sphere with two points O and D on its surface and one point P not on the sphere (P not necessarily in the plane of C,O,D). Faxén's formula applies to the special case where C,D,P are collinear.

Without detailed experimental information, the physical interpretation to be applied to such a general formula is largely a matter of choice. Part of the information required, of course, is precisely that referred to by Preston, namely, the shape of the surfaces of isodiffusion (expression due to J. Laval), particularly when $(i - i_B)$ is *not* small. Such experimental observations, made in this Laboratory, show quite definitely that in general these surfaces are *not spherical.* For diamond, indeed, the reflecting region around the (111) reciprocal lattice point has been shown to possess six horns pointing along the six [100] directions[3]. Unfortunately, however, even this information is not enough. M. v. Laue[4] has shown, for example, that for a finite crystal of octahedral shape, the reflecting region around a reciprocal lattice point has eight horns, but either wave theory will lead to similarly shaped regions provided that along certain crystal directions the atoms tend to remain always in phase.



The experimental information most to be desired at present is that relating the surfaces of isodiffusion for various reciprocal lattice points (to be experimentally determined) with other physical properties of the crystal, such as temperature, perfection, elasticity coefficients, and so on. Work along these lines is now in progress, but it is clear that the subject opens up a very wide and fascinating field of research.

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Albemarle Street,
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March 27.

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[1] Jauncey, Nature 147, 146 (1941).

[2] Preston, Nature, 147, 358 (1941).

[3] Lonsdale, K., and Smith, H., *Proc. Roy. Soc.*, A, in the course publication.

[4] v. Laue, *Ann. Phys.*, 26, 55 (1936); 29, 211 (1937); Thomson and Cochrane, "Theory and Practice of Electron Diffraction" (Macmillan, 1939), p. 75.

A Property of Conjugated Systems

In a compound of the type $X.(CH = CH)_nY$, the conjugated system is an electronic conductor between the covalent groups X and Y, and there must therefore be a correspondence between such chemical properties of the compound as leave the conjugated system intact and those of the covalent compound $X.Y$. This generalization has been recognized in the particular case of carbonyl compounds, but its wide value as a very general means of insight into the reactivity, as well as the mechanism of reactivity, of the compound $X.Y$, seems to have been overlooked.

The most readily available conjugated systems are those of *ortho-* and *para-*benzene derivatives, and the generalization at once disposes of the old supposition of a fundamental contrast between aromatic and open-chain chemistry. Nevertheless, the possibility of nitrating paraffins which, in this light, follows from that of nitrating alkyl benzenes, has only latterly been realized and put into technical operation. This example also serves to illustrate the efficacy of the aromatic resonance in promoting reactivity, a factor which must be allowed for in applying the principle. Although it is for this reason safer to deduce the behaviour of XY from that of the conjugated compound than to do the reverse, nevertheless it is clear that the possibility of chlorinating or nitrating XH to $X\,Cl$ or $X\,NO_2$ can provide a criterion of the ortho-para directive effect in aromatic substitution.

Again, the mechanism of *para-*nitrosation of dimethyl aniline must be reproduced in that of dimethylamine, and it is obviously not permissible to regard the latter as involving the salt of the base if, as is accepted, the former involves the free base. The widely accepted view, based on the results of kinetic measurements[1], that nitrosation and diazotization involve the salts of bases, is therefore untenable; the function of the protons, which such measurements show to participate in the reaction, must therefore be to activate the nitrous acid. It is, however, hoped to show in a fuller discussion of this reaction that other reasons independently point to the same conclusion.

The principle also constitutes a bridge between organic and inorganic chemistry, of the more value because in the latter the study of reactivity and mechanism is little advanced. Thus the mode of oxidation of hydrogen peroxide, hydroxylamine, and hydrazine respectively must correspond to those of hydroquinone, *p*-aminophenol and *p*-phenylene diamine. The *o-p* nitration of chlorobenzene must be reflected in that of hydrogen chloride, which doubtless represents the first stage in the familiar formation of nitrosyl chloride and chlorine. The nitration of aniline (as acetanilide) shows that, as indeed Franchimont[2] surmised, nitramide is an intermediate in the preparation of nitrous oxide from ammonium nitrate; similarly, the formation of nitrogen from ammonium nitrite is, as has also been shown kinetically[1], a case of diazotization.

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March 28.

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[1] Hantzsch and Schumann, *Ber.*, 321, 1691 (1899); Taylor, *J. Chem. Soc.* 1090, 1897 (1928); 2032 (1929); Schmid, *Z. Elektrochem.*, 39, 863 (1933); 42, 579 (1936).

[2] *Rec. Trav. Chim.*, 2, 94 (1883).

RESEARCH ITEMS

Stimulation of Algal Growth by Ultra-Violet Radiation

The research on this topic, which has been progressing for some time at the Smithsonian Institution, has produced results of considerable interest, and the recent contribution by F. M. Chase (*Smithsonian Misc. Coll.*, 99, No. 17) promises to be of importance in some aspects of the physiology of development. Cells of the alga *Stichococcus bacillaris* exposed repeatedly to the stimulative action of four wave-lengths of the ultra-violet grow much more rapidly than do the controls. Four successive irradiations at 2352 A., for example, stimulate the cells to a growth-rate (as measured by cell number) of 4·7 times the controls. This stimulation is of the same order for the first irradiation by all four wave-lengths employed (2352 A., 2483 A., 2652 A., 2967 A.), but in general the additional stimulation on further irradiation is the less marked the longer the wave-length. The interesting point about this stimulation is that the enhanced growth-rate leads not only to a decrease in cell length, as might be anticipated, but also to a somewhat increased cell breadth. The volume relations are more complex. On first stimulation the volume of a cell is greater than controls for all four wave-lengths, and on second stimulation for the two longer wave-lengths. With the very rapid multiplication which occurs at the shorter wave-length the volume soon falls below that of the controls. The changes which thus occur in the appearance of the cells, and these are quite striking judging from the published photographs, are permanent. The irradiated cells are also changed somewhat in internal organization, for they are now less sensitive to lethal exposures to ultra-violet than are untreated controls.

Coco-nut Disease in Jamaica

The rapid destruction of coco-nuts in the western end of Jamaica is now considered to be due to bronze leaf wilt (F. M. Bain, *Bull.* 22, Dept. Sci. and Agr., Jamaica, 1940). As well as producing characteristic leaf symptoms, the disease also results in a dropping of the nuts. Unsatisfactory conditions of water supply within the plant tissues are held responsible for the pathological symptoms observed. Affected plants may show a progressive dying back during several seasons with eventual mortality, or, as may also happen, the plant may die suddenly. Both types of the disease are related to conditions of moisture deficiency, and are referable to the details of root distribution, root mortality, soil type, and soil moisture relationships—on all of which points the author has advanced new and interesting data. It is possible, for example, to make a working classification of the soil types and characteristics on which wilt disease may be expected to occur. From such considerations the author reaches the conclusion that the application of curative measures in the field is impracticable, except in areas where affections of the progressive type are still in an early stage. Preventive measures also present serious difficulties, including the economic aspect, and in some instances direct attention to the need for securing alternative paying crops. Drainage, irrigation, trenching, mulching, manuring and spacing may each and all, in suitable circumstances, be expected to afford some alleviation of this type of wilt.

Development of the Seed in Angiosperms

R. A. Brink and D. C. Cooper (*Bot. Gaz.*, **102**, 1–25 ; 1940) have studied the histology of double fertilization and its effect on the developing embryo of alfalfa. They show that 34·4 per cent of fertile ovules abort within 144 hours after self-pollination, whereas only 7·1 per cent abort after cross-pollination. This abortion is due to the inability of the endosperm to keep pace with the growth of the surrounding tissues. The embryonic cells increase in an arithmetical progression, whereas the nuclei of the endosperm are without cell walls and increase geometrically during this period. The rate of growth of endosperm after cross-fertilization is significantly greater than after self-fertilization. Statistical data on the development of the embryo and endosperm are provided and the role of double fertilization in seed formation is discussed. The physiological advantages of double fertilization in angiosperms and the evolutionary connexion between incompatibility, heterosis, double fertilization and cross-pollination are pointed out.

Œnothera cantabrigiana

B. M. Davies (*Genetics*, **25**, 433–437 ; 1940) found plants in the Cambridge Botanic Garden which were similar to *Œnothera biennis* but which had red anthocyanin pigmentation on various parts. Cytogenetical analysis showed that these plants gave *laeta* and *velutina* forms in the same way as *biennis*, but in place of *rubens* being given by the pollen and *albicans* by the pollen as in *Œ. biennis*, these are given by the egg and pollen respectively in *Œ. cantabrigiana* ; the pollen and egg lethals have crossed over.

Heterosis

A further contribution to the problem of heterosis has been made by work on the tomato by E. S. J. Hatcher (*Ann. Bot.*, N.S., **4**, 735–765 ; 1941). There are high correlations between number of seeds in the fruit, weight of seed and fruit weight. Size heterosis appears at the stage of differentiation of the cotyledon primordia in the embryo. Embryo size at maturity is largely influenced by the maternal tissue, therefore reciprocal hybrids may have different embryo sizes. After germination, the cotyledons but not the plumule-meristem show heterosis in the hybrids. It is shown that embryo size is in no way determinate—indeed heterosis only becomes obvious after the flowering stage, while seeds of the same genotype which differed considerably in weight gave rise to plants of uniform size. The author therefore supports the theory of Jones involving complementary action of dominant factors.

Metamorphism in New Zealand

An early Palæozoic geosyncline appears to have occupied the greater part of Otago in the south of New Zealand, and in it was deposited a thick series of quartzo-felspathic sediments, interstratified with other types and with contemporaneous basic volcanic rocks. Probably in Permian or early Triassic time these rocks were folded and subjected to regional metamorphism. The details of this metamorphism on the rocks of an area of about a thousand square miles in the Lake Wakatipu region of Western Otago have been thoroughly investigated by C. O. Hutton, whose results have recently appeared (*Geol. Mem. N.Z. Dept. Sci. Ind. Res.*, No. 5, pp. 84 + 17 plates; 1940). The region furnishes an excellent example of progressive metamorphism within the chlorite zone, which has been subdivided into four subzones based on textural criteria and the degree of reconstitution suffered by the rocks of greywacke composition, which are here dominant. Subzone 1 is represented by slightly altered greywackes with lack of foliation. In 2 foliation appears, the rocks are semi-schists, and clastic grains are much reduced in size and number. As the isograd between 2 and 3 is reached, reconstitution becomes more complete and the clastic grains disappear. The rocks of 3 are perfectly schistose and include quartzo-felspathic schists and albite-epidote-chlorite-schists. The major part of the area falls into subzone 4, the rocks of which are characterized by a marked increase of grain size and of coarseness of foliation. In the associated green schists greenish biotite becomes abundant, but the red-brown variety of the biotite zone is not developed. The types derived from greywackes have quartz and albite as the dominant minerals, generally accompanied by epidote with chlorite or actinolite. The memoir is well illustrated and the petrographic descriptions are supported by many new chemical analyses.

The Shallowater Meteorite

THE meteorite of this name was found near Shallowater, Lubbock County, Texas, in 1936, the weight of the stone being 4,750 gm. It is an extremely coarsely crystalline aubrite composed of 81 per cent of enstatite, 5 of fosterite, 2 of oligoclase, 9 of nickel-iron, 1·5 of troilite and 1·5 of miscellaneous constituents (W. F. Foshag, *Amer. Min.*, 779–786; December 1940). A remarkable feature of the magnesium silicate minerals is their practical freedom from iron. The enstatite occurs as lath-like crystals up to 4·5 cm. long arranged in a coarsely reticulating texture. This fact, together with the lack of any evidence of the derivation of the enstatite from a monoclinic form, and the occurrence of olivine as grains in the enstatite, suggests to the author that the stone may be a product of direct crystallization from a magma, and not an accumulation of crystals from a magma of different composition. A more serious difficulty in interpreting the mode of origin of the stone is the association of nickel-iron and troilite (FeS) with iron-free silicates that normally contain iron. It is hard to believe that there was such an extraordinarily fine balance of the oxygen supply during crystallization that there was just sufficient to satisfy the magnesium and none available for any of the iron, particularly as the peculiarity is shared by other aubrites. On the other hand, there are indications that the nickel-iron and troilite may have been later introductions. Evidently this problem of the relation of nickel-iron to silicates in stony meteorites requires serious attention.

Tin Research

THE art of coating metals with tin by dipping them into the molten metal is one of considerable antiquity, and this method of tinning, known as 'hot-tinning', is still the most widely used. In recent years there have been considerable advances in the method of electro-deposition, but it may be said that the two processes fall into two distinct categories. By the hot-tinning process bright lustrous coatings up to 0·001 in. in thickness may be obtained and they do not tarnish readily. Electro-deposited coatings may be of any desired thickness but are matt when they emerge from the plating bath and give only a satin finish when polished. The hot-tinning process depends on experience and personal skill, and laboratory control is not necessary. As a result, the process has been neglected by research workers. Literature and technical data are very scanty and it is therefore very timely that a book should have been issued by the Tin Research Institute, Greenford (Publication No. 102: "Hot-Tinning" by C. E. Horner. Pp. 28) dealing with the processes used in hot-tinning fabricated articles of various kinds but not including the manufacture of tinplate or the continuous tinning of strip or wire. After describing the preliminary processes of degreasing and pickling, the book discusses the various types of tinning baths, their operating temperatures and their maintenance in continuous operation. Much of the value of the publication lies in the explanations given of the advantages associated with the different processes, of the causes of blemishes, of the conditions which influence the brightness of the coating and other practical points. Its contents are based on the experience and information accumulated by the Institute over a number of years and on the experimental work carried on in its laboratories. Although only a brief review of the subject, the directions given on the hot-tinning of articles of steel, iron, copper and copper alloys will be found of the utmost practical value.

Figures of the Earth and Moon

A PAPER on this subject by Harold Jeffreys (*Mon. Not. Roy. Astro. Soc.*, **101**, 1) is supplementary to a previous paper which appeared about four years ago (*Mon. Not.*, **97**). Immediately after the publication of the latter paper, E. W. Brown published a correction to the solar contributions to the motions of the moon's node and perigee, and this necessitated certain corrections to the determinations by Jeffreys, which were given in a revised solution (NATURE, **139**, 471; 1937). Jeffreys has also made a new discussion of the observations of gravity over the surface of the earth and has attempted to determine the harmonics of low order other than the main elliptic term (*Mon. Not. Geophys. Suppl.*, **5**, 1). While there is good evidence that some harmonics other than the main ellipticity term are present, "the data are not adequate to separate them, mostly on account of the lack of data for the South Pacific and high southern latitudes". The new estimate of the main ellipticity term in gravity contains an uncertainty because it rests on a hypothesis of randomness which will require further check. Jeffreys has made a complete new solution, in the first paper referred to above, for the constants involved, and the results are considered satisfactory. A difficulty arises in the disagreement between the moon's dynamical and visual parallaxes. Lambert has shown (*Astrophys. J.*, **38**, 181–5; 1928) that the dynamical parallax exceeds the visual by 0·16″ if the ellipticity is taken as 1/297, and agreement is reached if it is taken as 1/293·5, but it is suggested that the discrepancy may be due to an abnormal deflexion of the vertical at Cape Town.

CRYSTALS AND PHOTONS

In his presidential address to the Indian Academy of Science, Sir C. V. Raman surveyed recent progress in the investigation of those phenomena which are observed when radiation is scattered in a crystal (*Current Science*, January 1941. Supplement). The subject is a natural extension of the well-known Raman effect usually observed in liquids, which has proved such a fruitful source of knowledge concerning molecular vibrations.

The analogous effects observed in crystals are, according to Raman and his collaborators, the result of interaction between the incident radiation and the material particles of the crystal. As a result of the absorption of energy from the incident beam, the regular geometrical array of atoms or molecules in the crystal is set into vibration. The lattice waves in the crystal can then be regarded as stratifications of density which may reflect the energy preferentially in certain directions. Owing to the interchange of energy between radiation and matter, the reflected ray suffers a change of wave-length. Thus when a diamond is illuminated by monochromatic radiation, the scattered ray contains two components with wave numbers differing by $\pm$ 1332 cm.$^{-1}$ from the wave number of the incident ray. This change of frequency appears on the quantum theory as the result of an exchange of energy between a photon and the crystal, a diminution occurring if the photon is the donor and the crystal the acceptor, an increase if the reverse is the case.

In the experiment just described, the radiation is scattered in all directions from the crystal; but Sir C. V. Raman also envisages circumstances in which the incident radiation is regularly reflected in certain directions. He states that infra-red radiation, within a certain range characteristic of the material, is strongly reflected backwards by the crystal because the optical vibrations of the lattice are powerfully excited by the incident waves. Recently, the observation of similar phenomena has been extended to the range of X-ray frequencies. According to Raman, the optical vibrations of the lattice, excited by the incident X-rays, create dynamic stratifications of the electron density, and these give regular reflexion of X-rays with a change of frequency in much the same way that the static planes of atoms give the classical Bragg reflexions without change of frequency.

These ideas are obviously of great interest, especially with regard to the reflexion of X-rays. This part of the subject has received considerable attention in both Europe and the United States. Reference to the correspondence columns of NATURE in the last year or two shows that the X-ray phenomena which Raman describes have been ascribed by other investigators to reflexion from the thermal waves in the lattice. The difference in point of view seems to be that Raman considers the lattice waves to be a result of excitation by the incident energy, and he also postulates a frequency change in the scattered energy. His case would be greatly strengthened by direct observation of this frequency change, which is, unfortunately, too small to be detected at present. The other approach to the problem regards the lattice waves as being already present in the crystal as a result of the thermal vibrations of the atoms, and the observed effects do, in fact, appear to be explicable on these lines. Whether a quantum mechanism is necessary for an accurate description of the phenomenon would seem to be a matter for still further investigation (see also p. 467 of this issue).

DAMS AND THE PROBLEM OF MIGRATORY FISHES

The special symposium issue, with the above title, of the *Stanford Ichthyological Bulletin*, published through the co-operation of the Fish Commission of the State of Oregon and the Natural History Museum of Stanford University, comprises a number of papers read by leading fishery authorities in the United States on the problem presented by the construction of dams for generating electric power and for irrigation of agricultural land in certain States on the Pacific seaboard of North America.

The dams in question—already constructed or to be constructed—are in the basins of the Columbia and Sacramento Rivers. The fish mainly affected are the anadromous Pacific salmon (Oncorrhyncus)—chinook, blue back and cohoe—and the steel-head trout; fish which are of great importance in connexion with the world-famed commercial fisheries of the North American Pacific coast. Consideration has had to be given to the question of the effect these dams will have not only on the ascent of the breeding fish to their customary spawning grounds (and on the spawning grounds themselves) but also on the descent of the fry (and spent adults).

Fundamentally, a proposition of this nature resolves itself into the formulation of two questions, namely, (*a*) are such industrial developments on a river compatible with the continued maintenance of the fisheries in that river, and (*b*) if the answer is in the negative, are the fisheries to be regarded as of secondary importance and therefore inevitably to be sacrificed—the issue being the relative merits of each *quâ* progress ? A subsidiary question will be the cost of the necessary measures involved under (*a*) to safeguard the fishery interests. If the cost is high it may be urged that the proposition really comes under heading (*b*).

At the outset neither of these questions seems to have even suggested itself to the industrial interests bent on exploiting these rivers as power generators. Nor does it appear that the central authorities vested with the power of supervisory administration (and whose consent had to be obtained in the first instance) were any more alive to the situation and to its implications. It devolved upon the fishery interests, through the American Bureau of Fisheries, to direct attention to the probable effect on the fisheries and to the very considerable monetary value to the community at large of those fisheries. Incidentally, these schemes were apparently initiated in connexion with the relief of unemployment

In the Columbia River system four of the dams are either already constructed or in process of being constructed; and there are nineteen others contemplated. In the Sacramento River two are constructed, or nearing completion, and the erection of fourteen others is under contemplation. The heights of two of these are mentioned, namely, at Grand Coulee on the Columbia River, 350 ft., and at Shasta on the Upper Sacramento River, 560 ft. The United States fishery experts are therefore obviously confronted with a problem of exceptional magnitude. How they are proposing to tackle it is set out in the symposium.

As regards the Grand Coulee Dam alone, which is going to eliminate some 600 miles of main river and 530 miles of tributaries as breeding ground, it is estimated that the runs of fish involved represent an annual value of an investment amounting to a capital outlay of 11,000,000 dollars yielding 4 per cent (or approximately £88,000 per annum), this area representing apparently about one third of the total catchment area of the Columbia River.

Grand Coulee Dam is 350 ft. in height; and the fishery experts have reached the conclusion that any measures devised to facilitate the ascent of fish to the waters above would cost at least 2,000,000 dollars "with a very good chance that they would not work". These measures, moreover, would be irrespective of what would have to be done—if practicable—to safeguard the downward migrating fry and spent fish (in this case the spent fish would be only among the steel-head trout, as all the so-called salmon of the Pacific die after spawning once).

The only alternative presenting itself was to divert the fish that would normally spawn above the site of the dam to tributaries entering the river below, where they would be held until ready to spawn, the intention being to let the fish spawn in the natural way in the spawning grounds previously investigated and regarded as probably suitable and adequate. The means adopted to secure this diversion, the difficulties and expense involved, are described.

The diversion had to be effected by actually transporting the fish from a dam (of surmountable dimensions) lower down. The fish were deposited at the mouth of the stream draining the tributary system selected (which was racked to prevent them dropping down stream), but unfortunately the fish failed to proceed upstream to the appointed place. Accordingly they had to be transported to where it had been intended they should go, and where they were retained until ripe eventually for stripping, the ova being fertilized and hatched artificially and the fry distributed over the selected rearing grounds.

It is, as yet, by no means certain that success will attend these efforts. Whether the available rearing ground will prove adequate for the quantity of fry released, and if so whether the returning adults resulting therefrom will be disposed to find the same streams where they were reared as fry, or whether they also will have to be diverted by actual transportation as were their progenitors, remains to be seen.

In the Sacramento River system the problem seems to be an even harder one. Here the embankment of the dam being constructed will be 560 ft. in height. It will impound the waters not only of the upper third of the Sacramento River itself but of the whole of the McCloud and Pit Rivers, permanently cutting off some 112 miles of previously available spawning and rearing ground.

In view of its cost and its problematical practical value when constructed—having regard to the height to be surmounted and to the seasonal fluctuations of the surface water-level (amounting to upwards of 200 ft.)—the idea of a fish pass had to be abandoned. There remain the alternatives of either diverting the fish to other still available spawning grounds in tributaries entering the main river below the dam or, after collecting the spawners, hand stripping the fish and sowing the fry in waters where they would have a chance of developing and from which they could migrate downstream without danger to themselves. From previous counts that have been made of the runs of fish going up past the site of the Shasta Dam it is estimated that in the case of the second alternative a total of approximately 100 million ova would have to be handled, "a number greater than that which is now produced by all the federal salmon hatcheries".

Schemes of this magnitude are not (and are never likely to be) encountered in Great Britain. There are, however, a number of impounding dams in England and Wales and (as yet not so many) in Scotland for the storage of water required by townships for domestic and industrial purposes. These are mainly in the headwaters of rivers, and though considerably less in height and dimensions than those which are the subject of discussion in the symposium under consideration, the problem they have presented has points in common.

The dams themselves are, of course, quite insurmountable by ascending fish and, because until recently the technique of dealing with the fluctuating surface-level of the reservoirs created by the dam had not been grasped, the notion of a fish pass to enable the fish to get up had been more or less dismissed. In any event the consequent extensive flooding of country above the dam so reduces the available area of spawning and rearing ground that the cost of a fish pass was deemed to be scarcely worth while. Moreover, the question of the descending fry and spent fish remained unsolved owing to the fluctuating top-water level of the reservoir and consequently to the uncertainty as to where, when and how egress could be found for them.

The difficulties presented as regards the ascent of the breeding fish and the subsequent descent of the fry and kelts have now to some extent been met by the idea of a fish pass with an adjustable feed from the reservoir, as has been adopted at Tongland (where the range of fluctuation in the top-water level does not exceed 41 ft.) and at the other impounding reservoirs on the same river system (the Kirkcudbright Dee) which are comprised in the Galloway Power Scheme.

At Tongland a large proportion of the fry pass through the turbines apparently without serious harm. The remainder, together with the spent fish, eventually find their way to the fish pass intake. The Tongland dam is 72 ft. in height and is the lowest situated of the series of dams, being immediately above the tidal water. It was, therefore, of vital importance to make it surmountable if the salmon of the Dee were not to be exterminated. That the measures taken to that end have been successful is apparently the case, and it can be assumed that the similar measures at the other dams above have been equally successful.

Though Tongland and its associated dams store water for power and not for distribution, the principle involved is the same as that applying to large imdounding dams generally. In each case there is the problem of assisting the fish (descending as well as ascending) over or round the dam, complicated by the fact that the top-water level of the reservoir varies according to meteorological and seasonal conditions.

An additional problem presented by, and peculiar to, the impounding of water for generating power, as distinct from supply, is the draw through the turbines. If there is adequate clearance between the blades, and the revolutions per minute do not exceed a certain—as yet not fully determined—maximum, small fish, such as smolts, can pass through, as they do at Tongland (and elsewhere) without hurt. It is probably better to let these small fish avail themselves of a quick exit from the reservoir by this, usually more readily found, route rather than compel them, by the interposition of closely interspaced gratings at the turbine intake, to seek it after probable delay through the fish pass intake. Screened, but by a grating with relatively wide interspaces, the turbine intake must be, however, to prevent the larger adults, spent and dropping downstream as kelts, from getting involved in the turbines, with certainly fatal results—to the fish.

It might be supposed that what has been possible on the Dee at Tongland would be equally possible on the Columbia and Sacramento Rivers. The magnitude of the proposition on the latter rivers, however, removes it to a somewhat different category. On no single river system in Britain has it been nor is it likely to be, necessary to contemplate an overflow at any dam amounting to as much as 650,000 cu. ft. (as at the Grand Coulee on the Columbia River), or an annual catch of salmon exceeding 1,500,000 lb. (as is the case in regard to one commercial fishery alone at the mouth of the Sacramento River).

It requires no exceptionally acute imaginative faculty to realize that the problem in these Pacific coast rivers is on a scale which introduces a somewhat different standard of outlook and demands a special mode of treatment.

The fight of the fishery interests to prevent the extermination of these important and valuable fisheries will be watched with sympathetic interest.

THE INTERNAL COMBUSTION ENGINE

THE full text of the series of three Cantor Lectures of the Royal Society of Arts delivered by Prof. S. J. Davies under the title "Recent Developments in Internal Combustion Engines", is now available (*J. Roy. Soc. Arts*, Feb. 1941).

In his opening remarks Prof. Davies quoted the prophecy made by Sir Frederick Bramwell at the jubilee meeting of the British Association in 1881 with respect to the steam engine: "I very much doubt whether those who meet here fifty years hence will then speak of that motor except in the character of a curiosity to be found in a museum"; such was the overwhelming opinion he had formed regarding the internal combustion engine. While the steam engine, including the steam turbine, has found success in certain definite fields of application, as has its rival in others, it cannot be denied that the internal combustion engine has, due to its special advantages, opened up fields of application, not closed to but only remotely accessible by the steam engine. Of these the highest is that of aeronautics, in which the present-day performance of the engines in use is such as Bramwell could not have imagined.

The first of these three lectures was in the nature of a general survey, outlining the development of the various types of engine as regards combustion, materials and manufacture. It is only in the last twenty years or thereabouts that the processes of combustion in petrol engines have been elucidated. Such well-recognized phenomena as 'pinking' and 'knocking' were known to be of importance in practice, but only the vaguest ideas were prevalent regarding the conditions which give rise to them. Although finality has by no means been reached, the systematic investigations of Ricardo and others have given the engine designer a sound basis on which to work.

In the compression-ignition type of engine, the development of 'airless' injection has been the most important improvement in combustion processes, as the resulting simplification of the engine has extended its field of application and given an impetus to its further improvement. Striking developments have also taken place in the materials used in their construction and in methods of manufacture, with great advantages in the reduction of weight relative to power.

The steadily increasing speeds at which internal combustion engines are now designed to operate has led to a virtual modification of the working cycle from the constant-pressure combustion proposed by Diesel to one approximating more closely to the constant-volume combustion of the petrol engine. In the petrol engine the direct injection of the fuel avoids the loss which otherwise occurs during the scavenging process in the two-stroke cycle and has opened up a wider field for this type. Prof. Davies expressed the view that the development of two-stroke petrol engines for aircraft appears to be within the range of practical possibility, and that, given success in this field, the extension of two-stroke working to all forms of petrol engines used in transport may be only a matter of time. Discussing the relative merits of carburation and fuel injection for aircraft engines, he gave it as his opinion that, if the two systems had started together forty years ago, fuel injection would have been in universal use to-day. The secret development work done by the Germans to make fuel injection satisfactory has enabled them to use it in all their fighter and bomber aircraft. Given a satisfactory arrangement of the controls, it offers the advantages of elimination of freezing, better distribution, low consumption at reduced brake mean pressures, lower hydraulic resistance in induction by the absence of choke and the possibility of two-stroke working.

An interesting comparison was made between the Rolls-Royce Merlin and a captured Daimler-Benz engine. Both develop practically the same power at take-off, but as the former is 27 litres against 33·9 of the German and their respective speeds are 3,000 and 2,400 r.p.m., the specific rating of the British engine is much higher. The Rolls-Royce has a two-speed drive to its supercharger, while the Daimler-Benz has an infinitely variable hydraulic drive which permits of the speed and therefore the charge being suitably adjusted to altitude. Prof. Davies stressed the need for improved superchargers and scavenging pumps, as increased efficiency of these gives the advantages of reduced power required to drive them, lower cycle temperature with increase of charge density and of volumetric efficiency.

A type of engine of which little has been heard in Great Britain is the coal-dust engine, a point of some importance since British coals are more suitable for the purpose than those found in Germany, where development work has been done on this type. Diesel himself originally proposed such an engine but was unable to make it practicable. The Schichau Company of Elbing has carried out researches on a single-cylinder engine developing 160 h.p. at 200 r.p.m. Commercially, it has found the delivery of coal-dust ready for use direct from the mine in trucks to be most suitable, and the special removal of ash from the coal-dust to be uneconomical. Ignition temperatures vary from 300° C. for lignite to 600° C. for anthracite. The dust is used in the same fineness as for boilers, finer grinding being unnecessary as only 2 per cent in calorific value is lost to exhaust.

An auxiliary ante-chamber attached to the cylinder serves as a lock in free communication with the cylinder, and the fuel is admitted to the lock chamber by the fuel valve during the later part of the suction stroke, at the end of which the valve closes. During the instroke, compressed heated air is admitted and partial combustion occurs in the lock chamber as top dead-centre is reached. The resulting excess pressure in the chamber evacuates the contents into the cylinder during the expansion stroke. A continuous brake thermal efficiency of 25 per cent has been attained, but the main difficulties include wear of cylinder liner, wear, leakage and fracture of piston rings, pitting, erosion and sticking of the fuel-valve, and burning and erosion of the ante-chamber nozzles.

Concluding with some remarks on future developments, Prof. Davies pointed to the importance of research. For the last Schneider Trophy races the improvements in the aerodynamic properties of the aircraft and in the performance and reliability of the Rolls-Royce engine were obtained from comparatively modest outlays privately provided. Such an example shows the vast possibilities of well-directed research, and the reward of funds provided for the purpose.

FORTHCOMING EVENTS

Tuesday, April 22

Institution of Civil Engineers (Road Engineering Section) (at Great George Street, London, S.W.1), at 5 p.m.—Mr. Arthur John Hamblin Clayton: "Road Traffic Calculations".

Wednesday, April 23

Geological Society of London (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Prof. T. Neville George: "The Development of the Towy and Upper Usk Drainage Pattern".

Friday, April 25

Institution of Mechanical Engineers (at Storey's Gate, London, S.W.1), at 2 p.m.—Mr. G. E. Windeler: "Mechanical Mishaps".

North-East Coast Institution of Engineers and Shipbuilders (at the Mining Institute, Newcastle-upon-Tyne), at 6.45 p.m.—Prof. J. F. Baker, and Mr. J. W. Roderick: "Plastic Theory: its Application to Design".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Graduate Teacher qualified in Electrical Engineering in the Blackburn Municipal Technical College—The Director of Education, Education Offices, Library Street, Blackburn (April 23).

Chief Education Officer to the Darlington County Borough Education Committee—The Chief Education Officer, Education Office, Darlington (April 28).

Woman Graduate Lecturer in Education at the Bingley Training College—The Education Officer, County Hall, Wakefield, Yorks. (May 2).

Assistant to the Director of Education with special reference to Elementary and Secondary Education—The Director of Education, Education Offices, Leopold Street, Sheffield 1 (May 3).

Civil Engineering Assistant to the Tees Valley Water Board—The Engineer and Manager, Water Board Offices, Corporation Road, Middlesbrough (May 5).

Research Officer in the Mental Disease Research Department—The Secretary, The University, Edmund Street, Birmingham 3 (May 16).

Reader in Pharmacology—The Secretary, The University, Edmund Street, Birmingham 3 (June 1).

Assistant Engineer for the Sudan Government Railways—The Controller, Sudan Government London Office, Oxford Hotel, 261 Clifton Drive South, Lytham St. Annes, Lancs. (quoting 'Assistant Engineer').

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 46, Section A, No. 9: Boolean Algebra and Probability Theory. By T. S. Broderick and E. Schrödinger. Pp. 103–112. 1*s*. Vol. 46, Section A, No. 10: Matrices of the Finite Period. By Olga Taussky and John Todd. Pp. 113–122. 1*s*. Vol. 46, Section A, No. 11: The Region of Bright Nebulosity in the Coal Sack. By E. M. Lindsay. Pp. 123–128+2 plates. 1*s*. Vol. 46, Section B, No. 6: Note of the Cytology of Human Uterine Glands in the Gravid Phase. By J. Brontë Gatenby and Olive E. Aykroyd. Pp. 97–100+plate 7. 1*s*. Vol. 46, Section B, No. 7: The Effects of Ultracentrifuging Human Oocytes. By Olive E. Aykroyd. Pp. 101–108+plates 8–10. 1*s*. Vol. 46, Section B, Nos. 8, 9: Description of Six New Species of Bassine Ichneumon-Flies, with Notes of some Others; A New Species of *Blacus* (Hymenoptera: Braconidæ), with some Notes of other Species of the Genus. By A. W. Stelfox. Pp. 109–124. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [113

Proceedings of the Royal Society of Edinburgh. Section B (Biology). Vol. 61, Part 1, No. 1: The Œsophagus of the Stenoglossan Prosobranchs. By Alastair Graham. Pp. 24. (Edinburgh and London: Oliver and Boyd.) 2*s*. [193

Other Countries

Report of the Secretary of the Smithsonian Institution and Financial Report of the Executive Committee of the Board of Regents for the Year ended June 30, 1940. (Publication 3600.) Pp. ix+115. (Washington, D.C.: Government Printing Office.) 25 cents. [113

Fisheries Research Board of Canada. Bulletin No. 59: The Chemistry and Technology of Marine Animal Oils, with Particular Reference to those of Canada. Edited by H. N. Brocklesby. Pp. 442. (Toronto: Fisheries Research Board of Canada, Toronto University.) Paper, 2.95 dollars; cloth, 3.80 dollars. [113

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 34: Some Practical Results of Sugarcane Research in India. Pp. 41. (Delhi: Manager of Publications.) 1.8 rupees; 2*s*. 3*d*. [133

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 135: Investigations on the Storage of Jonathan Apples grown in Victoria. By Dr. S. A. Trout, G. B. Tindale and Dr. F. E. Huelin. Pp. 96+4 plates. (Melbourne: Government Printer.) [143

Annals of the Carnegie Museum. Vol. 28, Art. 11: An Archæological Collection from the Belcher Islands in Hudson Bay. By Diamond Jenness. Pp. 189–206+plates 14–22. (Pittsburgh, Pa.: Carnegie Museum.) [143

Field Museum of Natural History. Zoological Series, Vol. 24, No. 16. Reptiles and Amphibians from Central Arabia. By Karl P. Schmidt. Pp. 161–166. 10 cents. Zoological Series, Vol. 24, No. 17: Malacological Notes, 2: A New Marine Prosobranch Snail from the Yucatan Coast. By Fritz Haas. Pp. 167–174+1 plate. 30 cents. Zoological Series, Vol. 24, No. 18: New Termitophilous Diptera from the Neotropics. By Charles H. Seevers. Pp. 175–194. 15 cents. (Chicago: Field Museum of Natural History.) [193

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SCIENTIFIC ADMINISTRATION IN NATIONAL AND LOCAL GOVERNMENT

THE attack on the Civil Service launched by Lord Percy in the House of Lords recently, is only one among many indications of disquiet about the efficiency of national administration in a democracy in times of peace as well as in the stress of war. It is not only from the national point of view, however, that the question of government and administrative efficiency is being raised anew. Just as in the national sphere we are being forced to consider the limitation of national sovereignty and even the transfer of certain powers to a federation if world order is to be established, so within the nation we are being forced to reconsider the units of local administration. The forces which in certain fields of public service were already making for regionalism have been powerfully reinforced by the exigencies of war. Under its influence and that of the regional organization developed for civil defence, the character of local government is being profoundly modified. Not only its efficiency but also its scope and character are coming in for reconsideration and development.

These circumstances give pertinence to a number of studies of public undertakings which have appeared in recent years. We have had, for example, "Public Enterprise", a series of studies of developments in social ownership and control in Great Britain, covering the Port of London Authority, the Forestry Commission, the British Broadcasting Corporation, the Central Electricity Board, the London Passenger Transport Board, the Post Office, and others, edited for the New Fabian Record Bureau by Dr. W. A. Robson. Mr. T. H. O'Brien's "British Experiments in Public Ownership and Control" is one of a new series of studies under a recent scheme promoted by the Institute of Public Administration, and confines itself to the Central Electricity Board, the British Broadcasting Corporation and the London Passenger Transport Board. Dr. W. A. Robson's "The Government and Misgovernment of London" is a further important contribution, while still more recently, in "Advisory Bodies : a Study of their Uses in Relation to Central Government", by the Oxford University Politics Research Group, we have a careful examination of an instrument to which much importance was attached by Lord Haldane in the Machinery of Government Report.

One of the most difficult questions, and one which is at the same time closely related to the problems of regionalism, is that of municipal trading, examined by Dr. Herman Finer in a recently published volume.* Concentrating his attention on the four main municipal undertakings—electricity, gas, transport and water—he discusses the various theoretical problems raised by municipal enterprise, a brief survey of the historical development of municipal trading being followed by an account of the legal framework.

The main interest of this study at the present time lies in those parts of the second book, concerned with factors in production, which deal with administrative organization and personnel and with the size of the undertaking, and in the concluding observations on the balance of deterrents from, and incentives to, efficiency, and the factors of success and their development which comprise the fourth book.

Dr. Finer's principal criticism of the administrative organization relates to the size of the managing committees. The large membership is required because the committees in charge of undertakings are representative of the council, and the council representative of the electorate is not conducive to a high degree of responsibility. Control of public enterprise tends to be anticipatory, to avoid the errors which have been seen to occur in private enterprise. On the other hand, it is recognized that the greatest single decision which a committee can make is the choice of its technical chief. Upon his expertness, and, just as much upon his character as an administrator and vision as a business man, the solvency and service of the undertaking depend; and generally speaking the committee is regarded as responsible for policy, while the manager is responsible for administration and is given a free hand in the planning of development and the execution of policy.

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* Municipal Trading : a Study in Public Administration. By Dr. Herman Finer. Pp. 432. (London : George Allen and Unwin, Ltd., 1941.) 16s. net.

The conclusion is reached that, with few exceptions, municipal undertakings in Great Britain are efficiently administered, but while the weak spot of anticipatory control is referred to, insufficient stress is placed upon the extent to which conditions to-day are demanding a more dynamic and creative type of administration. These demands are made both in the field of policy and in that of day-to-day administration, and the extent to which war conditions have revealed the shortcomings of those who are merely capable of routine administration, only accentuates a weakness which was already becoming apparent in local and national administration in time of peace. It will no longer be sufficient for municipal undertakings to demonstrate their capacity for routine administration. They must show now that they also possess wide vision and powers of innovation and creative development—the power to see the services for which they are responsible in terms of wider national needs, and the capacity to judge between conflicting views of the public interest in those services.

It is the great merit of studies of the character of Dr. Finer's survey that they bring to light inherent weaknesses and facilitate the provision of correctives. The healthiest single factor in the success of municipal undertakings, he points out, has been direct democratic control, and for this reason he would deprecate any reorganization of these utilities on the lines of the semi-public corporation, of which he is severely critical, owing to its remoteness from control by the consumer. The development of that task of adult education in citizenship, and particularly in the functioning of, and application of, democratic methods upon which the continuance of genuine and efficient local government really depends, is calculated in itself to stimulate the provision of both a better type of councillor and committee man, and the supply of officials of the highest administrative capacity.

The technical officers are of critical importance. They, after all, are members of a profession, and for all save the very exceptional men will be limited by the general standard of their profession, just as that standard from another point of view ensures the maintenance of a high standard of efficiency. It is a welcome sign that professional men are increasingly taking an interest in the wider horizons of their profession and in the relation to post-war reconstruction, as indicated by Sir John Orr's address to the British Medical Association, Prof. A. V. Hill's address to the Parliamentary and Scientific Committee (see NATURE, March 1, p. 250), and Dr. John V. N. Dorr's address as Perkin medallist of the Society of Chemical Industry on the engineer and his responsibilities to the world of to-day and to-morrow.

It is only as the scientific worker and other professional men no longer content themselves with the easy task of criticizing the routine and timidity of civil service administration, but accept their own wider responsibilities and attempt to make positive contributions to the development of administrators characterized by creative ability and the capacity to promote energetic and far-reaching projects, and seeing opportunities rather than difficulties, that we can hope for advance. The administrator, whatever his professional origin, who is to use his opportunities to the full and carry with him those whose vision is narrower and who are less willing to co-operate or to take risks, needs not only the assurance of professional tradition but also the inspiration of professional ideals. Much might yet be done, even in its present form, to raise the outlook and character of local government and administration and to stimulate co-ordination, regionalism and the reorganization of areas, if the technical officers in municipal undertakings had the support of a wide and generous outlook and understanding from their professional associations.

Among the suggestions which Dr. Finer advances for improvement in the efficiency of municipal enterprise is steadfast and determined attention to the selection of officers of all grades. He advocates a much severer probation, and that technical officers as well as the administrative and clerical staffs should be compelled to take some such course as that prescribed for the diploma of public administration instituted at various universities. Those managing undertakings must learn to appreciate their strength, and also the weaknesses against which they must continually pit their determination, so that they may be equal to the even severer demands which the necessary co-ordination and reorganization of areas will involve.

The possibilities of interchange of staff mentioned by Prof. A. V. Hill in his address referred to above, should also be given serious consideration. If we could once more stimulate the exchange and movement of technical and scientific workers between Government departments, local authorities, the universities and industry itself, the advantages in creative work as well as administrative outlook and efficiency would be far-reaching, from the scientific, technical, social and national point of view. The value of thus stimulating creative thought and checking departmentalism should make well worth while the effort required to develop a uniform pensions scheme, calculated to assist and encourage mobility whether between Government departments, the local government services, the universities or even industry. Even if the attempt can only be made over a part of the field, co-operation between Government service and the universities as suggested by Prof. Hill is a promising line of advance. Moreover, the wider experience and outlook which flow from increased mobility should assist to throw up administrators of the type so urgently required. Local government services have in fact done little to implement the findings of the Hadow Committee, nor have such public corporations as the British Broadcasting Corporation, the London Passenger Transport Board or the Central Electricity Board realized the possibilities which are before them of handling staff problems so as to develop an administrative service free from even the defects for which the Civil Service has been criticized.

FORESTRY ADMINISTRATION

Colonial Forest Administration

By Prof. R. S. Troup. Pp. xii+476+32 plates. (London: Oxford University Press, 1940.) 35*s*. net.

FORESTERS throughout the Empire will be glad to learn through the publication of this book that Prof. Troup was just able to complete this important work, which it was generally known he had in hand, before being struck down by the illness which proved fatal; from the prefatory note we learn that it fell to Mrs. Troup and Prof. H. M. Steven to see it through the press. One can confidently say that no one, but Troup with his exceptionally wide experience and clarity of thought and expression, could have written it. For both presentation of subject and printing we have nothing but praise, and do not remember ever having read through a book of 450 pages on forestry which revealed so few points calling for criticism. There may be, however, one rather fundamental doubt about it, and that is whether, in view of the public for which the book is stated to be written, namely, probationers and officers of the Colonial Administrative Service, it is not too lengthy and too expensive. The cost and length will, we believe, prevent its purchase by a large number of potential readers who would find it of great interest and value; it is too good a book to be referred to occasionally in the library, and but for these difficulties should surely find a place on the private bookshelf of all foresters and others interested in forestry.

The preface explains how the subject-matter of a short course of lectures has come to be expanded to so solid a volume, but we feel that a significant amount of the more technical aspects of forestry, such as a discussion of the mean and current annual increment and details of working-plan procedure, could have been omitted, though their inclusion undoubtedly results in the presentation to the administrator of a more finished picture of forestry in general. As it is, it can confidently be asserted that no colonial administrator or forester can read the book without finding a great deal of useful information new to him, whilst some of the surveys such as those on the effects of forest destruction and on the character and distribution of forests are masterpieces of skilful compression; the explanation of a working plan and sylvicultural systems is equally good. The book as a whole also answers extremely well the common query: "What does a forester do?"

The book is divided into two parts. Part 1 deals on broad lines with all the major heads of forestry, such as the influence of forest on climate, soil erosion, the effects of forest destruction and measures for protection, forest reservation, State control, etc. Part 2 takes the units of the Colonial Empire in turn and describes the major points of policy and administration in each.

A few points noted during perusal of the book may be mentioned. In Section (? lecture) VI, the account of cover crops for soil conservation is perhaps not altogether up to date and the impression is wrongly conveyed that *Tephrosia candida* is a small tree similar to *Leucœna glauca*. The importance of growing the most suitable variety or strain of seed requires mention either in this Section, as for *Prosopis glandulosa*, or in that on plantation work (XII) as for teak.

In Section VIII, a point that might have been more stressed is that the clearing of good forest in the tropics by no means necessarily gives good agricultural land.

In Section IX, as an important point in practice, rather more might have been said on one of the indirect effects of uncontrolled grazing, especially of goats, and that is the intensive lopping which always accompanies it, leading to selective extermination of fodder species. More might have been said of the experiments of recent years under the head of seasonal closure when at least part of an area must be kept open at any given time. So important is the warning that undue multiplication of stock must be prevented before it is too late that one would have liked to see it more heavily underlined; unfortunately the usual history is that no effective action is taken by the administrator on the forest officer's continued complaining until control has become far more difficult and unpopular than it would have been had the trouble been nipped in the bud. Declaration of grazing policy is a sound measure, but critical examination of the Central Provinces, India, the example quoted, would reveal its very weak spot of accepting a very bad *status quo* in overgrazed forests.

In Section XI, recent very successful extensions of the *taungya* method in thickly populated tracts, often with the primary object of meeting villagers' needs even for tree loppings, might have been referred to as a possible pointer for future development.

In Section XII, the data for employment given by forest operations are useful as also the demonstration of the magnitude of the demand on the forest of factory or mining activities. It is pointed out that where denudation is rampant the pinch first comes in a shortage of fuel: this might have been developed with the common picture of the fields being deprived of cattle manure because this is the only available substitute for wood fuel. In Section XIII, on forest exploitation, the author repeatedly emphasizes the importance of pushing the use of second-class timbers, a step the need of which is almost universally felt in the more extensive forest tracts and must be given the closest attention. In Section XIV, dealing with ownership, etc., one would have liked some indication of the extent to which laws concerning forest control on private land have actually been acted on.

We feel that a note of warning on the risks involved in settling forest villages would have been in place in Section XV. Instances could be quoted where, for whatever reason, the forest work which it was intended to do through their agency has not been properly done and the land occupied has ultimately been excised from the forest to form a centre of all the usual troubles over grazing, lopping, felling and fire damage that are characteristic of squatters' settlements in the middle of a forest. The figure given for the annual shifting cultivation area in Nigeria will come as a surprise and a shock to many.

In Section XVI, it is pointed out that the South African gold mines need the produce from 100,000 acres of plantation annually, but one misses an explanation as to how this huge demand is being met at present.

Section XIX, dealing with administration, includes a note of warning which will be endorsed by many practising foresters, against undue specialization in the earlier stages of development. The first duty of a young or small department is to give the forests in its charge really effective protection and simple conservative management.

Section XX deals with education and research. Every forest officer who has been in India knows how much of the executive work is done by the trained subordinate staff, particularly the rangers, and Troup finds repeated occasion to rub in the importance in various directions of building up a similar staff in the Colonial Dependencies.

The accounts in Part II of the forest policy and position in the several colonies give a historical account of the forest administration leading up to the current policy; this is followed by a summary of the procedure for reservation, which is frequently influenced by differences in form of ownership of the land, and concludes with area statistics. These accounts, of which there are as many as twenty, vary in length from 3 to 10 pages, not necessarily in proportion to the area of forests, and will be found exceedingly useful for reference.

Finally, there are five appendixes which are also very welcome as collecting information hitherto not readily available on forests and water supply, forestry in relation to tsetse fly control, legislative and administrative action taken in regard to protective forestry, colonial mining laws and timber rights, and a list of colonial forest laws.

The forty-four half-tone reproductions of photographs used to illustrate the text are very well selected and of a standard one has come to expect of Troup and the Oxford University Press.

H. G. CHAMPION.

THEORY OF KNOWLEDGE

The Analysis of Knowledge

By Prof. Ledger Wood. Pp. 264. (London: George Allen and Unwin, Ltd., 1940.) 12*s.* 6*d.* net.

THIS work on the theory of knowledge has distinct merits. It is well arranged, well written and discusses all the subjects that should be discussed. The author deals with sense experience and memory, perceptual knowledge of 'things', of our own selves and other persons, the generalized knowledge of science and the knowledge implied in judgments of value. However, the book as a whole is disappointing.

In treating of perception the author criticizes the 'sense-datum' school of writers on grounds that certainly do not apply to Broad or Price. His own theory seems to be just the sense-datum theory with a slight change in terminology. He takes no account of what Gestalt psychology has to say about the objects of experience, and does not mention the important discussion in Blanshard's "Nature of Thought". He emphasizes at the beginning that all thought is referential, pointing to something beyond itself. One would suppose that this implied that relations are as real as any of the terms they relate, yet in Chapter vii he maintains that universals, including of course relations, are concepts, in the sense of being mental entities having no reference to anything beyond themselves. Worse still, in the last chapter he states a correspondence theory of truth, which implies a realist view of universals, since, as he says, truth is a property of propositions and since every proposition contains at least one universal term.

The best and most original feature of the book is the chapter on valuational knowledge, though it is confined to ethical judgments. The author perhaps makes undue use of the ambiguity of the term 'ideal', but he deserves credit for realizing that, however naturalistic a theory of knowledge may be, it cannot exclude value judgments, and for an ingenious method of including them.

If Prof. Wood could be induced to accept a realist view of universals (under the guidance of Peirce, Russell or Whitehead) to clear up some minor inconsistencies and to consider what Köhler and Blanshard have to say about facts of experience (only authors resident in his own country have been named), there are here the elements of a valuable theory.

AIR NAVIGATION

The Observer's Book on Astro-Navigation

By Francis Chichester. Part 1. Pp. 103. Part 2. Pp. 83. (Observers' Books, Nos. 3 and 4.) (London: George Allen and Unwin, Ltd., 1940.) 2*s.* 6*d.* net each.

IT is commonly thought that the determination of the position of a moving aircraft by means of astronomical observations is a difficult and complicated business. Actually, the principles involved are of extreme simplicity, and the working out of the observations takes at the most a few minutes with the aid of the *Air Almanac* and suitable altitude-azimuth tables to provide the solutions of the spherical triangles.

The observation of the altitude of a celestial body places the observer on a small circle, the centre of which is at the point on the earth's surface that has the body in its zenith at the instant of observation, and the radius of which is the complement of the observed altitude. The portion of this circle in the vicinity of the observer's position can be regarded as a straight line, and is known as a position line. The intersection of two position lines, allowance being made for the motion of the observer between the two observations, fixes the observer's position.

To draw the position line, any convenient position for the aircraft, somewhere near its estimated position, may be assumed. The position line will be independent of the assumed position. The surface navigator has been tied for too long to his dead reckoning position, which has no special virtue. In air navigation, an assumed position is adopted such that the altitude-azimuth tables require no interpolation. With the aid of the *Air Almanac* and the *Astro-Navigation Tables*, both prepared by the Nautical Almanac Office for the Air Ministry, the reductions are reduced to their simplest possible forms.

In these two small volumes, by an experienced air navigator, the methods and principles involved are explained in clear and simple language. Specimen pages from the *Air Almanac* are reproduced and their use is described. A number of hypothetical observations (for which the astronomical data can be obtained from these pages) are fully worked out to illustrate the methods, according as observations are made of stars, the Pole star, planets, the sun or moon. The principles of the bubble air sextant are explained and the methods of observation are described.

These volumes are eminently practical and can be strongly recommended to all navigators. They can be read in an hour or two and should help to dispel the mistaken belief that there is anything mysterious or complicated in the principles and methods of air navigation. H. S. J.

THE TEACHING OF BIOLOGY

(1) Animal Biology

By Robert H. Wolcott. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. xxi + 649. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 24*s*. 6*d*.

(2) Human Biology

By Prof. George Alfred Baitsell. (McGraw-Hill Publications in the Zoological Sciences.) Pp. xv + 621. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 26*s*.

(1) THE basic themes around which this course in zoology is built are: life as a chemicophysical basis and life as a manifestation of metabolism. The choice of title is a happy one, for the course here devised is truly a biological one, and should cause most authorities responsible for general university degree courses in Great Britain to think whether their teaching is not too much based on systematics and type systems, at the expense of animal physiology.

Having got a course in animal biology (as opposed to zoology) it is not a very far cry to general biology; since Prof. Wolcott has proved possible, and even desirable, a course in animal biology up to university degree standard, it should be no more difficult to devise a course of the same standard in general biology—a course of study which is practically non-existent in Great Britain. Indeed, even in this avowedly "Animal Biology" the author has recourse to plants in such topics as tropisms, photosynthesis, alternation of generations, etc. Maybe the day will come when students in all universities can take a degree course in general biology, instead of the present botany and/or zoology courses. Until that day comes, there will perforce be a lack of good teachers of biology in schools, with the consequent backward condition of the teaching of the subject. It is surely a reflection on our system of teacher training that even now many teachers of biology in schools have either not qualified in the subject or are specialists in botany or zoology, and consequently either biased or ill-informed, or both.

At this stage, therefore, we would strongly recommend all students of zoology and certainly all teachers of biology to read Prof. Wolcott's book. Though he does not ignore zoological 'types' altogether, he does, on the other hand, lay special emphasis on general, comparative and economic aspects under such chapter headings as: energy, protoplasm, metabolism, plants and animals, behaviour, Protozoa and diseases, tissues, fertilization, reflex action, anthropoid apes and man, structure of organisms, developments, ecology, animal organisms in health and diseases, and so forth.

(2) Prof. Baitsell's book strikes an even more novel note, basing an introductory study of biology on a study of man himself. The author's reason for such a course is sound, being based on "the increasing realization . . . that the majority of students beginning work in college biology were, inherently, far more interested in acquiring knowledge about the human organism than they were concerning any other living species". We believe this to be true in the majority of cases.

Here again, plant biology is utilized in the study of certain aspects of the subject. The text is by no means medical. It is a real biology with man as the main 'type', though others are frequently called upon, for example, the development of the frog, chick, other mammals, in leading up to growth and reproduction in man.

There are an interesting chapter on disease and a very extensive appendix of ninety-three pages which will do much to prevent the student's thoughts being devoted solely to man. The appendix is unusual in being arranged alphabetically in encyclopædia fashion. It deals with such diverse subjects as acetylcholine, Amœba, Aristotle, biology of medicine, Brownian movement, colloids, diffusion, germ plasm, taxonomy, history, pneumonia, etc.

Both these books are by American biologists and therefore might with advantage be consulted by British students and teachers, since biology is an academic and cultural subject of study and has made greater progress in the United States than in Great Britain. But the live British biologists are aware of our shortcomings and will welcome the aid offered by such as these books.

Kungl. Svenska Vetenskapsakademien:

Förhistoria, Grundläggning och Första Organisation. Av Bengt Hildebrand. Pp. xv+672. Noter, Bilagor M.M. Pp. v+673–886. (Stockholm: Kungl. Svenska Vetenskapsakademien, 1939).

In these two volumes, Dr. Hildebrand gives an account of the inception, foundation and early years of the Royal Swedish Academy of Sciences, which is now two hundred years old. Already in the seventeenth century the spirit of research in the natural sciences was afoot, and the tendency to do away with Latin in place of the worker's national language was gaining ground. There was, however, a strong utilitarian bias in scientific work. The Royal Society of London and the Academy of Science of Paris showed the way to pure research. The foundation of these and later that of the Academy of Science of Russia prepared the way in Sweden. A few attempts to found learned societies failed, for the universities still were dominated by the dead languages, but in 1728 the Royal Society of Sciences was founded in Uppsala. About the same time the capital saw the start of academies of music, painting and literature, and in 1739 the Academy of Science was founded on the model of the Royal Society and the French Academy of Science; two years later it received a royal charter.

Among the founders was Linnæus, who became its first president. The early bias of the academy towards economic problems was not maintained beyond the beginning of the nineteenth century, and up to that time much attention had been paid also to work in mathematics and natural science. In 1813 agriculture founded its own academy, and under Berzelius the Royal Swedish Academy devoted itself more and more to natural science, giving up humanistic and practical studies.

Dr. Hildebrand traces in detail all these changes and the background against which they took place, and he gives a long account of the work of all the founders, as well as the original constitution and descriptions of the library and museum. There is an exhaustive bibliography on all aspects of the work.

R. N. R. B.

Analytical Processes:

a Physico-Chemical Interpretation. By Dr. T. B. Smith. Pp. viii+470. (London: Edward Arnold and Co., 1940.) 18*s*. net.

During the past ten years, many important advances have been made in physical chemistry, and it is not surprising, therefore, that a new edition of Smith's "Analytical Processes" has now made its appearance. This new edition incorporates recent developments, and some sections of the first edition dealing with fundamental relationships have been dropped.

To appreciate this book fully, the reader must be fully conversant with the basic principles of physical chemistry, and the volume is therefore of particular value to senior students or to those making physical chemistry their special study. The author's object is to give full scientific explanations of the theories underlying analytical processes, since only those who have a thorough knowledge of such theory can ever approach, with any hope of real success, the many new problems arising in the examination of minerals and of new industrial products. Further, such knowledge is essential when sources of error in analytical processes have to be elucidated, minimized or removed.

This authoritative and advanced treatise is indispensable not only to those who are engaged in a university course, but also to technical chemists whose duties lie in industrial chemical analysis.

Practical Histology and Embryology

By Dr. Nellie B. Eales. Pp. xi+111. (London: Macmillan and Co., Ltd., 1940.) 3*s*. 6*d*. net.

This little book provides an excellent guide to practical work for first-year students in histology and vertebrate embryology. Dr. Eales is an experienced and successful teacher and knows well the pitfalls that lie in the way of the beginner. The simplest methods and a small number of fixatives and stains have been chosen out of the bewildering variety that are at the disposal of the more advanced worker. Directions are given for preparing simple histological injections and for the elementary technique of mammalian embryology, both of which are usually omitted from the first-year course. It may perhaps be suggested that the simplification of methods might perhaps have been carried a little further with advantage; that rough hand-cut sections might have been substituted oftener for the more elegant products of the microtome. Many beginners, and even some more advanced students, have great difficulty in relating the two-dimensional picture presented by a microtome section to the three-dimensional structure of a tissue or an embryo. Sections cut, however inexpertly, by the student himself, do help him over this difficulty.

Very few slips have caught the eye of the reviewer, but Canada balsam is not crystalline (p. 6), nor are teeth "epidermal products" (p. 63).

W. T. Calman.

Modern Diagnosis

Edited by Sir Humphry Rolleston and Dr. Alan Moncrieff. ("The Practitioner" Handbooks.) Pp. 286. (London: Eyre and Spottiswoode (Publishers), Ltd., 1940.) 12*s*. 6*d*. net.

The editors are to be congratulated on the choice of the twenty contributors to this volume, which consists of two parts, the first dealing with clinical diagnosis and the second with laboratory and special diagnosis. With the exception of an article specially written for the book by Dr. C. J. C. Britton on the technique of simple blood examinations and methods for collection of blood, all the contributions have previously appeared in the *Practitioner*, but have been revised and brought up to date. Although the work covers a wide range of subjects including neurology, dermatology, cardiology, pædiatics, gastro-intestinal disease, diabetes and chronic rheumatism, it makes no claim to discuss the whole field of medicine, but deals only with those subjects in which diagnosis is most difficult.

The book, of which the text is liberally interspersed with illustrations, is admirably suited for the general practitioner and senior student.

THE STUDY OF LAKE DEPOSITS

BY B. M. JENKIN, C. H. MORTIMER AND W. PENNINGTON,
FRESHWATER BIOLOGICAL ASSOCIATION, WRAY CASTLE, AMBLESIDE

LAKE deposits have proved to be of interest in various ways. They present convenient material for the study of the process of sedimentation and of the initial stages of sediment metamorphosis. They remain for long periods uninfluenced by erosion, weathering and other disturbances, and preserve in stratigraphical sequence such animal and plant remains as resist decomposition, and also the inorganic portion of the parent material. They record in varying completeness and detail the biological history of lakes and the climatic conditions in which sedimentation occurred.

In general the natural evolution of a lake is towards greater productivity associated with changes in the species composition of the phytoplankton[1]. In some cases this evolution may be recorded in the deposits in considerable detail. For example, striking changes accelerated by sewage pollution, occurring in Lake Zurich have been recorded and can be accurately dated in the deposits[2].

Climatic conditions may be recorded in a general way by the presence of some organisms, for example, plankton and tree pollen, which are indicators of definite climatic types. Late glacial sediments sometimes record climate in greater detail. De Geer[3] has successfully substantiated the hypothesis that the laminations (varves) in late glacial clays represent annual cycles in the deposition of silt carried by glacier streams into still water. Thicker layers of coarser particles correspond to floods produced by rapid summer melting, and the finer layers, alternating with these, represent winter sedimentation. Careful and detailed correlation of sections of varve deposits from a great number of localities in Fenno-Scandinavia led to the establishment of a detailed climate chronology for the late-glacial period of ice recession in that region. It was possible to connect this with recent time by the study of the deposits of Ragunda lake in northern Sweden. These deposits present a fairly complete series of annual laminations from the time when the ice sheet retreated northward from that lake until 1796 when the lake was accidentally drained. This period, which the latest estimates put at close on nine thousand years, may indicate the order of magnitude of the period during which post-glacial sedimentation has continued in the British Lake District and Scottish Highland lakes.

In Great Britain little work has been done on these interesting lines of investigation until the last few years, during which the deposits of Windermere and other waters of the Lake District have been studied by the Freshwater Biological Association. In an earlier communication[4] the value of echo-sounding apparatus for the survey of certain types of lake deposit was demonstrated, and now this is followed by an account of work on cores of Windermere deposit obtained with new apparatus. In the initial stages of this work, one of us (C. H. M.) obtained cores with a simple steel pipe operated from a boat and driven in by a ramming weight. These cores showed the zonation of laminated clays and organic layers, indicated in core *A*, Fig. 2, and the diatoms (examined by W. P.) exhibited an interesting succession. We are grateful to the Royal Society for a grant enabling this work to be continued with improved apparatus.

THE CORE-SAMPLER

In spite of its simplicity, an open-ended sampling pipe used for obtaining cores has disadvantages which have been previously discussed by Jenkin and Mortimer[5]. Some other types of core-sampling gear were briefly described and the working principles of an improved apparatus (designed by B. M. J.) were outlined in the same communication. This apparatus in modified form has now been successfully operated in Windermere, and cores of up to 6·5 m. in length have been obtained under 65 m. of water.

The core-sampler, illustrated diagrammatically in Fig. 1, is operated from a pontoon held in position by four anchors and consists of the core-cutter (*A,A'*), extension tube (*B*) and turning gear (*C.C*). The core-cutter, previously described in more detail[5], consists of an outer casing in the form of a tube, part of which is cut away and replaced by a flat face-plate, and an inner half-tube (the cutter). This is supported on a shaft, the rotation of which causes the cutter to pass out through a slit at the side of the face-plate, cut into the deposit and enclose a sample 1·25 m. long. As this operation is performed after the core-cutter has been lowered to the required depth in the deposit, and as the cutter follows a horizontal circular path into undisturbed deposit, distortion of the sample is reduced to a negligible minimum. The practical operational details are concerned with ensuring that the core-cutter is exactly at the required depth in the deposit, and with cutting out the sample and removing it for examination.

A sounding wire (*D*) passes over a pulley at the top of a vertical metre scale. The sampler is suspended by the hook (*E*) at the end of the cable from a crane. The extension tube (*B*), which is 15 ft. long, is connected at one end to the core-cutter and carries the turning gear at the other. The turning gear consists of a pair of skew-gear wheels, one of which is keyed to the vertical shaft which passes down through the extension tube and is coupled with the core-cutter shaft. The other wheel is mounted on a short horizontal shaft, which carries a grooved disk (*C*) at either end. Metal blocks (*F,F*), attached to the free ends of a wire bridle, fit into notches, one in either disk. Turning the disks counter-clockwise, with the blocks in the notches, winds the bridle on, rotates the shaft and turns the inner tube of the core-cutter back inside the casing (open position *A*).

SAMPLING OPERATION

The sounding wire is paid out until the weight rests on the bottom. The pivoted swing-arms (*G,G*) are locked by the trip-bolt (*H*) with their free ends embracing the sounding wire, but allowing it to pass freely between them and through the middle loop (*I*) of the turning gear bridle, which is also held between the ends of the arms. The sampler is then lowered by the crane until the swing-arms, which slide down the sounding wire as a guide, are felt to hit the stop (*J*) which has been so adjusted that the bottom of the core-cutter is at the mud surface at this point. Penetration into the deposit is measured on the metre scale by a pointer (*K*) fixed to the sounding wire, and is halted at the required depth.

To close the core-cutter and take the sample, a messenger weight slides down the sounding wire, strikes the trip-bolt (*H*), releasing the swing arms which are pulled to the open position (G′,G′) by rubber bands. The sounding wire is now pulled up and, as the loop (*I*) rests on the stop (*J*), this withdraws the bridle, turns the disks clockwise and closes the core-cutter (*A*′).

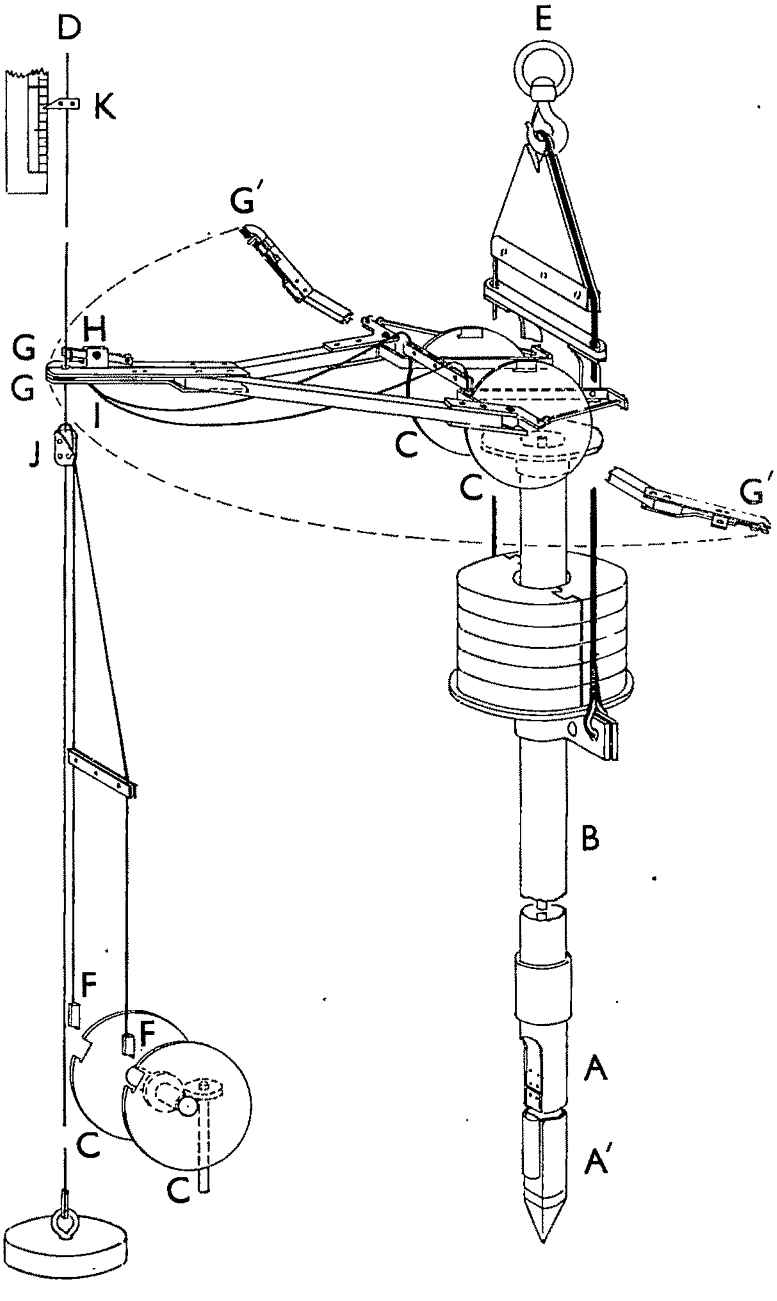

Fig. 1.
DIAGRAMMATIC ILLUSTRATION OF THE DEPOSIT SAMPLER

When raised to the surface, the weight of the sampler is transferred from the crane to two derricks and slings by the help of which it is laid face-plate upwards on a plank fixed along the side of the pontoon. After washing the outside, the core-cutter is opened by turning the disks counter-clockwise, exposing the sample on the face-plate. A sheet-iron tray is inserted between this and the sample, which is then removed for examination.

The above operation was repeated at each sampling station to obtain an overlapping series of samples, each 1·25 m. long. The weight of the sampler alone (200 lb.) was usually sufficient to penetrate the upper 2–3 m. of deposit. For deeper samples, up to 360 lb. of extra weight was added in the form of half-disks of lead, held together by dovetail projections and placed at the top of the extension tube above *B*. In work to date, the factor limiting the lengths of core obtained was the length of the extension tube.

THE CORES

With the apparatus described above a survey has been conducted of the bottom deposits of the North Basin of Windermere. Nineteen cores have been obtained in water depths ranging from 3 to 65 metres, in addition to the cores taken with the steel ramming tube. Fig. 2 shows two typical cores, from shallow and deep water respectively.

The soft, often semi-liquid surface muds are underlain by a varying thickness of firmer, dark-brown organic deposit, here called the brown mud, beneath which is a thick layer of pink laminated glacial clay, which is present in both deep and littoral regions. As was expected from the echo-sounding records[4], the total deposit, both organic mud and clay, is much thicker in deep water than in the littoral region. In cores from shallow water of less than 10 m., in the western bays, the lowest deposit is a fairly coarse gravel, which is at the base of the laminated clay, about 4 m. below the mud surface. In the deep central region, the total length of core obtained (6 m.) just included the upper layers of the laminated clay; but cores from the southern end of the North Basin, taken in about 30 m. of water, showed that here the laminated clay is 0·7–0·9 m. thick, and is underlain by a stiff, blue-grey, unstratified clay containing gravel and fragments of shale in its lower layers. It is probable that these gravels rest on the rock surface and, with the unstratified lower clay, probably represent late glacial deposits formed during the period when the lake basin was occupied by ice. Above them lies the laminated clay, the laminations of which consist of alternate layers of coarser and finer material. These are almost certainly varves, formed in the later period when only valley glaciers remained, and water occupied the present lake basin. In several cores the upper part of the laminated clay contains layers of grey silt with organic remains (diatom shells, moss plants, and in one core, leaf fragments), in contrast to the clay itself, which is practically devoid of organic remains. These organic layers appear to represent transitory periods during the retreat of the ice, when conditions in the lake were more favourable for plant growth.

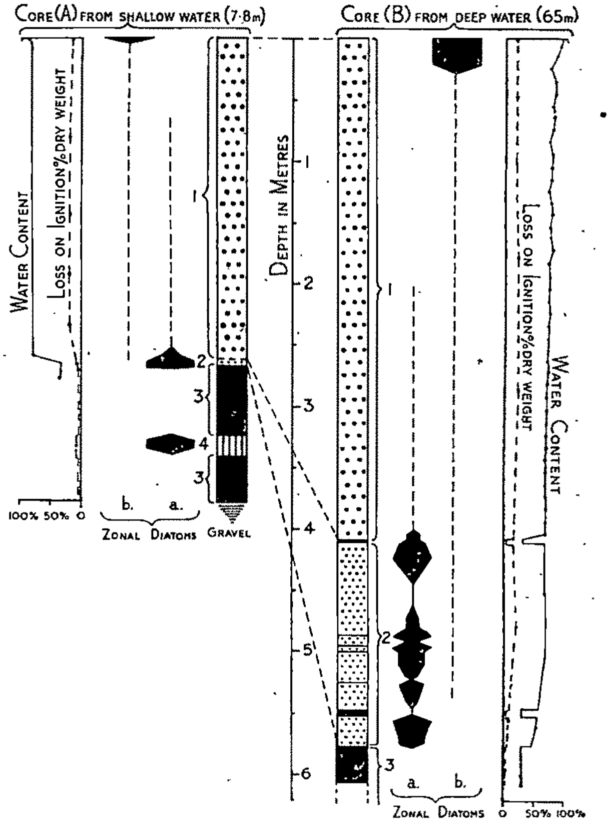
Core (A) from shallow water (7·8m)
Core (B) from deep water (65m)
Water Content
Loss on Ignition % dry weight
Depth in Metres
1
2
3
4
5
6
1
2
3
4
3
100% 50% 0
b.
a.
Zonal Diatoms
Gravel
1
2
3
a.
b.
Zonal Diatoms
0 50% 100%
Loss on Ignition % dry weight
Water Content

Fig. 2.

DIAGRAM OF A TYPICAL CORE FROM SHALLOW WATER AND ONE FROM DEEP WATER OF WINDERMERE, SHOWING THE DISTRIBUTION OF TWO ZONAL DIATOMS, AND GRAPHS OF WATER CONTENT AND LOSS ON IGNITION.

1, Brown Mud; 2, Zone of narrow clay bands; 3, Laminated glacial clay; 4, Diatomaceous layer in clay. Zonal diatoms: (*a*) *Melosira arenaria* cf. var. *hungarica*; (*b*) *Asterionella gracillima* + *A. formosa*. (*a* and *b* are not represented on the same scale.)

The deposits above the clay represent the Post-Glacial sediments, and it seems probable that, at least in deep water, they present a complete record of sedimentation over that period. In deep water, immediately above the laminated clay, there is a zone of 1·5 m. in which narrow bands of pink unlaminated clay are separated by brownish-grey organic deposits. These narrow clay bands show considerable local variation, but the thickest two

(1–4 cm.) are fairly constant in level in all cores from the deep area of the North Basin. All these narrow clay bands fade out laterally, and do not appear in the shallow water region, where this zone is represented only by a layer of brownish-grey silt, 5–10 cm. thick. The brown mud is 2·5 m. thick in shallow water, increasing to 4·0 m. in deep water. It is very uniform in appearance from top to bottom, and more organic than the silts between the narrow clays, but like them contains frequent narrow black or dark green layers of chlorite. In the delta region of the River Brathay, the largest river entering the lake, the brown mud is much thicker than elsewhere, and a core 5·4 m. long consisted entirely of this type of deposit.

Water content and loss on ignition are indicated in Fig. 2 for two typical cores. In the surface ooze a rapid fall occurs in water content, which was nearly 90 per cent at the surface and about 78 per cent at 30 cm. From this point downwards in the brown mud there was a gradual, somewhat irregular fall to about 70 per cent just above the clay. The density of the brown mud varied from 1·06 at the surface to 1·24 at the bottom. Variations in density may be attributed mainly to variations in water content, as the density of the dried brown mud was close on 1·6 from the top to 4 m. As might be expected, there was a sharp discontinuity between mud and clay. The top of the laminated clay was of fairly uniform water content (34–38 per cent) and density (1·70) in different regions of the lake. In the stiff unstratified blue clays, mentioned earlier, the water content fell to 24 per cent and the density rose to 1·97. Details of the distribution of loss on ignition may be seen in Fig. 2. Although irregular variations between 19–23 per cent occurred in the brown mud, there was no significant difference between top and bottom of this layer, but much lower values were found in the organic layers associated with the clays. The value for the clay was 3 per cent, which probably represents combined water. Loss on ignition in the brown mud and other organic layers may be taken as an index of organic content, as the error due to combined water can scarcely have been greater than 3 per cent.

COMPARISON OF CORES WITH ECHO-SOUNDING RECORDS

Cores were taken at or near positions for which echo-records obtained with a Husun recorder were available. Many of these records not only showed an echo from the floor of the lake, but also one or more echoes below this at distances of up to 13 m. below the mud surface. It was suggested[4] that these echoes represented reflexions from density discontinuities, such as might be expected to occur at mud-clay or clay-rock interfaces. It is now possible to compare the level of the top of the clay in the cores with the level of the first echo below the mud surface in the corresponding echo-records.

The simplest conclusion from this comparison is that the first echo below the mud surface comes from the top of the laminated clay or from the uppermost of the narrow clay bands in cores where this is well developed and more than 1 cm. thick. On this assumption, comparison between echo-records and eleven cores yields values for the velocity of sound in the brown mud which vary between $1{\cdot}54 \times 10^3$ and $1{\cdot}68 \times 10^3$ metres per second. This small variation indicates that the above interpretation of the echo-records is correct. The mean value $1{\cdot}6 \times 10^3$ metres per second or 1·14 times that in fresh water is comparable with velocities of longitudinal explosion waves found in clays and waterlogged glacial material[5]. If the velocity of sound in the laminated clay is similar to that found in the brown mud, the echo-records indicate that another density discontinuity, possibly a layer of gravel or rock, exists at 10–12 metres below the mud surface in the deep region of the North Basin.

ORGANIC REMAINS IN THE CORES

Diatom shells are abundant in the brown mud, the organic layers between the narrow clay bands, and in some of the organic layers in the laminated clay. In addition, a deposit of almost pure diatomaceous earth, 25–30 cm. thick, was found above the laminated clay in Low Wray Bay. The diatom content of all the cores has been studied, and the results show that three main phases in the past history of the lake can be distinguished.

It should be recognized that two main factors have been concerned in modification of the environment in the lake since glacial times: first, climatic changes affecting the whole region, and secondly, changes in the lake itself produced by silting and other causes. The first marked discontinuity in the cores is that separating the surface ooze from the underlying brown mud. This discontinuity occurs at 20 cm. below the mud surface in deep water, and rises nearer the surface as shallower water is approached, until it is about 5 cm. deep in water 5 m. in depth. The diatom flora of the ooze is characterized by *Asterionella formosa* Hassall and *A. gracillima* (Hantzsch) Heib. which, with *Cyclotella Kützingiana* Thwaites make up most of the diatom population. At the base of the ooze layer there is an abrupt drop in the numbers of Asterionella, which in the underlying layers becomes unimportant. According to Pearsall and Pearsall[7] a plankton dominated by Asterionella represents a late stage in the evolution of a glacial lake, and it is known that since the beginning of the present century there has been a considerable increase in the numbers of this diatom in Windermere, where the natural processes of evolution have been hastened by the increase in productivity consequent on sewage pollution. It is probable that this layer of ooze containing abundant Asterionella represents the deposit accumulated in the last fifty years or thereabouts.

The brown mud below the surface ooze has a very uniform flora, dominated by the plankton diatoms *Cyclotella Kützingiana*, *Tabellaria fenestrata*, Kütz., *T. flocculosa* (Roth) Kütz., and small littoral diatoms which are more abundant in the cores from shallow water. These species are abundant in all the diatomaceous layers, and, in numbers, make up the greater part of the diatom population throughout the cores.

On the other hand, the large and conspicuous diatom species show a marked zonation. The brown mud in all the cores is characterized by *Gomphonema geminatum* (Lyngb.) Ag. and *Pinnularia major* Kütz. These, especially the former, become less abundant with increasing depth, but there is no pronounced discontinuity in the brown mud. A very marked change occurs below the topmost narrow clay band, and in the corresponding narrow band of silt above the laminated clay in the littoral region. Here, most of the large species, except the two just mentioned, increase considerably in numbers, and two species which are absent or rare in the brown mud, namely, *Melosira arenaria* Moore *cf. var. hungarica* Pant. and *Campylodiscus noricus* Ehr, become abundant. This type of diatom assemblage is constant throughout this zone immediately above the laminated clay, and in the diatomaceous layers within the laminated clay. It therefore appears to be associated with the conditions under which glacial clay was deposited. It is interesting to note that workers on the sediments of Crystal Lake, Wisconsin, found that the lowest diatomaceous layers contained species which may be identical with those of the lower deposits of Windermere. It is possible that the brown mud of Windermere may have been laid down during the period since the early Boreal, while the deposits associated with the clays may have accumulated during the period of ice recession.

Unfortunately, pollen is very scarce in the deposits, and no satisfactory time-correlation can yet be made. The only layers containing appreciable quantities of pollen are the peat bands which occasionally occur in the soft deposits of the narrow clay zone. In the lowest of these layers, the pollen is practically all Pinus, while several layers towards the top of this zone contain oak, birch, alder and hazel pollen. This would seem to indicate deposition in Boreal and Atlantic times respectively, but the sediments associated with the lower layers contain a diatom flora similar to that of the supposed late-glacial silts occurring in the laminated clay. In the present state of our ignorance of the ecological requirements of diatom species and considering the fragmentary nature of the pollen figures, it is not possible to date the deposits with any certainty. It is possible, however, that measurements of the varves in the laminated clay may indicate some correlation between these and the time-scale established by De Geer from the Swedish and other varves.

Mr. D. J. Scourfield has examined the cores for animal remains, which were fairly frequent in the muds but apparently absent in the clays. Rhizopod tests and Cladocera fragments were frequent at all levels, while parts of insects, particularly Chironomus, and remains of small mites were occasionally found. By far the most abundant remains were those of Bosmina while three other planktonic Cladocera, Daphnia, Bythotrephes and Leptodora, and a considerable number of littoral forms belonging to the family Chydoridæ, were present. The same species occurred in all the cores in the brown mud, in the organic layers between the narrow clays and in the organic silts within the laminated clay. Although the remains are not sufficient to allow quantitative estimates to be made, it is concluded that the Cladoceran population has shown little if any change since glacial times, as all but one or two of the species recorded are living in the lake to-day. The absence of Daphnia valves and headshields and copepod remains in the cores is striking in view of their dominance in the zooplankton at present. This may perhaps be due to differences in rates of decay.

The main conclusions of this research are as follows: a successful method for raising undisturbed cores from the bottom deposits of lakes has been developed. The examination of cores so far obtained confirms the value of the echo-sounding machine as a means of providing data on certain types of lake deposit, and discloses a part of the climatic and biological history of Windermere.

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EXPLOSIVES*

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Imperial College of Science and Technology

Nature of an Explosive

An explosive is a store of chemical energy in liquid or solid form which can be rapidly converted into heat and thence into mechanical energy. The explosive products must be gaseous, either wholly or in part, because the heat energy of solid or liquid products is not directly available for doing work by expansion. It is a popular fallacy that an explosive is an unusually rich store of energy. The fact is, however, that with sufficient air petrol is, weight for weight, capable of doing nearly eight times as much work as nitroglycerine, which is one of the most powerful of explosives; but nitroglycerine does its work much more swiftly, disrupting and pushing away its surroundings in a fraction of a second.

There are several ways in which chemical energy can be stored to form an explosive. For example, we can mix a combustible material like sugar with an oxygen-rich compound such as potassium chlorate. A far more perfect apposition of combustible and oxygen is secured, however, when both are suitably combined into a single chemical compound. But this combination is a peculiar one, in that the combustible and the oxygen are only loosely or indirectly associated in the molecule, usually through the intermediary of some relatively inert atom such as nitrogen, as, for example, in ammonium nitrate. This is, however, not the only way of storing up chemical energy to form an explosive compound. Any compound is a store of chemical energy if a rearrangement of its constituent atoms is possible which is attended by the evolution of heat; and if the rearrangement can occur swiftly with the formation of gaseous products, then the compound is an explosive. Thus the dissociation of acetylene into soot (solid carbon) and molecular hydrogen liberates heat, and acetylene has long been recognized as an explosive gas, particularly when compressed. We can, most conveniently, effect this compression chemically, that is, by making use of some of the chemical energy stored in acetylene. Thus the hydrogen of acetylene is easily replaced by metals such as copper, silver and mercury. The resulting compounds are solids, so that their chemical energy is concentrated into a far smaller volume than in acetylene gas itself. These acetylides are violent explosives, which decompose into soot and a highly heated gas of metallic atoms. In this case it is the resolution of the acetylene triple bond into the single bonds of soot which is the source of the heat energy.

There are other kinds of atomic arrangements which can serve as stores of easily released chemical energy. For example, although the dilute hydrogen peroxide of commerce is harmless, the pure liquid compound is explosive and decomposes readily into steam and molecular oxygen. Pure ozone, especially in the liquid or solid state, is an even more violent explosive. In each case the removal of an oxygen atom from the molecule requires the expenditure of much energy, but this is more than balanced by the heat evolved by the subsequent union of two such atoms to form a molecule of oxygen. Another atomic grouping where, on explosion, the main source of heat energy is furnished by the combination of like atoms to the molecular state is the triazo, $-\mathrm{N}{=}\mathrm{N}{\equiv}\mathrm{N}$, group. Hydrazoic acid, HN_3, is an explosive liquid which readily forms a series of explosive metallic salts, of which lead azide is much used in the explosives industry.

An example of a class of compound in which the heat energy liberated on explosion results partly from the union of a combustible with an oxygen atom and partly from the formation of a molecule from like atoms is furnished by the fulminates. These are metallic salts of fulminic acid, $\mathrm{H}{-}\mathrm{O}{-}\mathrm{N}{\equiv}\mathrm{C}$, of which the best known is mercury fulminate, $Hg(ONC)_2$. On explosion, an atomic rearrangement takes place to yield as sole explosion products carbon monoxide, molecular nitrogen and mercury.

Sensitiveness

The sensitiveness of an explosive reflects its stability, being a measure of the energy required to dislocate the arrangement of the atoms in its constituent molecules to such an extent that they tend to relapse into a more stable configuration rather than to return into their original positions. It is difficult, however, to obtain an absolute measure of this 'least initiating energy', as it may be called, and in practice comparative tests must suffice. The results are sometimes conflicting; thus, nitroglycerine is less sensitive to a hammer blow, but more sensitive to heat than lead azide. Recent advances in our knowledge of crystal and molecular structure and of the nature of the chemical bond, seem to offer a fair prospect of a better understanding of the energy relationships involved in initiating the explosive process, at least in those compounds which are crystalline and of simple molecular structure, like, for example, the acetylides and the azides.

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* From a lecture at the Royal Institution delivered on February 11.

When an unconfined explosive is ignited by a flame, one is struck by the fact that, with certain few exceptions, explosives respond in one of two very different ways. Thus, match compositions, nitroglycerine, guncotton, blasting gelatine, cordite and gunpowder burn quietly, some more quickly than others, with flames of characteristic colour. Picric acid, trinitrotoluene and the aromatic nitrates in general burn sluggishly with a sooty flame. In striking contrast to this quiet burning is the behaviour of most of the acetylides, azides and the fulminates, which explode with great violence and set up intense shock waves when ignited. A closer examination reveals that this violent explosive process is preceded by a short period during which an initially slow rate of burning rapidly accelerates until the violently explosive stage is reached. In the case of burning, the energy needed to start decomposition in the hitherto unaffected portion of the explosive is handed on as heat from the burning zone to the adjacent unconsumed layer, which is thus ignited, and so on from layer to layer throughout the explosive. On the other hand, the succeeding violently explosive stage is due to the setting up, as the result of a rapidly accelerating rate of burning, of a steep-fronted sound wave which travels through the explosive at a high uniform speed. The intensity of this wave is so great, approaching 150,000 kgm./cm.^{2}, that the explosive at the wave front may momentarily be heated, by adiabatic compression, to a temperature of the order of 10,000° C., so that the resulting explosion is propagated hand-in-hand with, and maintains the intensity of, the shock wave in its passage throughout the explosive. In traversing an inert medium, such as air, this intensity of course decreases rapidly; nevertheless, the shock wave may still be capable of effecting explosion, even though attenuated by passage through a considerable air gap.

DETONANTS

The process whereby explosion is effected by a shock wave is known as detonation. An explosive which, even when unconfined, burns rapidly to detonation may be called a detonant. The shock wave is usually known as the detonation wave. Its velocity lies between 3,000 and 9,000 metres per second, and is related to that of sound in the same medium; hence, each explosive has its own characteristic and constant rate of detonation. The detonants, of which lead azide and mercury fulminate are the best known representatives, play a vital part in the use of modern high explosives.

Ability to burn to detonation is not necessarily associated with a high degree of sensitiveness, nor is it evidence of high energy contents of the explosive, as is sometimes supposed. For example, both nitroglycerine and cordite are roughly four times as powerful as mercury fulminate or lead azide. The explanation lies rather in the nature of the explosion products of such detonants, which are for the most part unable to dissociate appreciably, so that the chemical energy is transformed into heat in a single step instead of relatively slowly, by a succession of stages.

PROPELLANTS

The large class of explosives which burn quietly when unconfined may be further subdivided into propellants and the so-called high explosives, according to their behaviour when ignited by flame in a strong enclosure. A propellant, like gunpowder or cordite, merely burns. If it is non-porous and uniform in texture, like cordite, the propellant continues to burn from layer to layer at much the same uniform rate as when unenclosed, while a porous substance, like gunpowder or a partially gelatinized smokeless powder, burns at a less uniform rate because the accumulating pressure forces hot gases into the pores and thus increases the rate of burning. Under similar conditions a high explosive, after a more or less prolonged period of burning of somewhat uncertain duration, eventually detonates.

As the name implies, the function of a propellant is to propel a selected object in a desired direction. It is essential that the pressure of the explosion gases on the projectile should neither vary abruptly nor stress the gun unduly. At the same time the maximum permissible pressure should be continually exerted on the projectile and, to avoid waste, the charge must be completely consumed before the projectile arrives at the muzzle. These demands are met by a proper choice of the area-to-weight ratio of the propellant. For example, the cordite in a rifle cartridge consists of some fifty rods each about as thick as a darning needle. In a big gun, however, where the projectile takes much longer to arrive at the muzzle, the rods may exceed one inch in diameter.

An explosive which is liable to burn to detonation when confined as in a gun, is quite useless as a propellant. Should detonation occur, the gas pressure suddenly rises with such rapidity that the projectile cannot move fast enough to keep it within bounds, and the gun bursts and shatters into many fragments. Such disasters, or 'prematures' as they are sometimes called, were at one time by no means rare, and were due to the use of propellants of an unreliable nature. The possibility of a premature occurring with a modern high-class propellant like cordite is so remote as to be negligible. This does not imply that a propellant cannot be made to detonate like any high explosive, but rather that it will not do so under the conditions of its use in a gun.

High Explosives

In contrast to the propellants, the tasks which a high explosive has to perform are such as to require that its energy be made available in the shortest possible time. This can only be achieved by causing the explosive to detonate. If the gases were liberated slowly, as with a burning propellant, they would have time to open up weak places in the confining surroundings and then expand through these openings between the obstacles, instead of breaking up and flinging them away. For example, if the explosive charge in a shell were only to burn, then the slowly rising pressure would merely push out the fuse and the gases would escape through the fuse hole, leaving the shell intact. In the case of detonation, however, the gas pressure rises so quickly that there is no time for the inertia of the more easily removed obstacles to be overcome before the surroundings as a whole have been subjected to pressures which they cannot withstand. Hence when the shell-filling detonates, the shell walls are broken up into fragments which are pushed outwards with high velocity by the blast of the expanding gases of detonation. Similarly, a slab of guncotton, even though unenclosed and merely laid on a steel rail, will sever this on being detonated, but would leave it unharmed if the explosive were merely to burn.

When the manufacture of nitroglycerine had been established as a cheap commercial process, the problem of how to detonate it and thus unlock its energy to the best advantage became a pressing one. The solution was found in the discovery that the detonation wave in mercury fulminate, placed in contact with nitroglycerine, could set up in it a fresh detonation wave with a velocity characteristic of this medium.

Whilst the more sensitive high explosives, such as blasting gelatine and dry guncotton, can be detonated without fail in this manner, others, like moist guncotton and the aromatic nitro-compounds, especially when cast or highly compressed, are uncertain in their response to the effects of even relatively large amounts of detonant, being often merely broken up into fragments and scattered. The difficulty is overcome by interposing between the detonator and the main insensitive explosive a few grams of a high explosive which will respond with certainty to the action of the detonator, and then pass on its own detonation wave to the main body of the insensitive explosive. This intermediate explosive is generally known as the 'gaine.'

The choice of a high explosive is governed by the kind of work it will have to do, and by the treatment to which it is likely to be subjected before use. As shell fillings, only explosives which are highly insensitive to shock and friction can be used with safety; otherwise detonation may occur before the fuse acts, or even before the shell leaves the gun barrel. Also, the gaine explosive, and still more so the detonator contents, must be so packed and supported in the main body of the shell filling that they too can withstand with certainty the rough handling of being fired from the gun. Finally, when the filling does its work, the shell should break up into swiftly moving fragments of the most effective size, and not be merely split into a few large pieces or completely pulverized. If nearly all the chemical energy became available immediately on detonation, as is the case, for example, with lead azide, the shell would be broken up into powder and fragments too small for effective flight, and the explosive is said to be 'brisant' or shattering. On the other hand, if the chemical energy is transformed into heat by a succession of steps as, for example, where such easily dissociated molecules as steam and carbon dioxide form the bulk of the explosion products, the shell fragments are likely to be too large; an effect to which a low velocity of detonation may also indirectly contribute. Finally, in order that the fragments should move away with high velocity, or that the shell should do as much damage as possible on bursting after penetration into an obstacle, the explosive should have high chemical energy contents and yield only gaseous products. These requirements can best be met by mixing together two or more explosive compounds, a procedure which may have, among others, the advantage of enabling costs to be reduced. Amatol, a high explosive consisting of a mixture of trinitrotoluene and ammonium nitrate, was introduced as a shell filling during the War of 1914–18; it was cheap and proved remarkably successful.

The high explosives used for blasting in quarrying and mining can be sufficiently sensitive to respond to a detonator without the added complication of an intermediate gaine, because the treatment which they receive in the course of transport, handling, and in the final packing into the shothole, is mild compared with that which a shell filling has to withstand. Here again, the properties of the explosive must suit the work in hand. For example, in tunnelling through hard rock, a shattering and powerful explosive will serve best by breaking up the rock into small pieces easily handled for removal. On the other hand, for quarrying out large blocks of stone or in coal mining, where 'small stuff' represents waste, explosives are used which are comparatively slow in their action. Owing to the danger of coal dust and firedamp explosions, so called 'safety' explosives have been introduced for use in coal mining. These are slow-acting high explosives in which are incorporated substances like crystal soda which, by absorbing heat, prevent the temperature of the explosion flame from rising sufficiently to ignite coal-dust and methane-air mixtures.

OBITUARIES

Prof. William Bulloch, F.R.S.

PROF. WILLIAM BULLOCH, emeritus professor of bacteriology in the University of London, whose death occurred on February 11, was a bacteriologist of world repute and the historian of bacteriology. He took up the science of bacteriology in its early days and lived to see it reach its modern importance. In these early days there were but few masters, but he made it his aim either to study with them or make himself familiar with their ideas and technique, and with Koch, Salomonsen, Metchnikoff, Ehrlich and Roux he maintained an intimate friendship.

William Bulloch was born in Aberdeen in August 1868 and studied at the University there, taking his M.B., C.M. in 1890 and afterwards studying in several centres of learning on the Continent (Leipzig, Paris and Vienna). He was a brilliant student and was awarded many academic prizes and honours. Among the more important appointments which he held were that of assistant professor of pathology, University College, London, where he came into contact with David Ferrier and Victor Horsley; and bacteriologist at the Lister Institute, where he was associated with Lord Lister, of whom he became a life-long friend. In 1897 he was appointed bacteriologist to the London Hospital, to which he remained faithfully attached for the rest of his scientific career.

His great ability, his wide knowledge of his subject, and his integrity, soon established Bulloch as one of the foremost authorities on bacteriology in Great Britain, and for this reason he was invited to fulfil many important positions of trust. Thus he was chairman of the governors of the Lister Institute, an original member of the Medical Research Committee (Council), a member of the Government Committee on Foot and Mouth Disease, a member of the Committee of the Beit Memorial Trust, president of the Section of Pathology of the Royal Society of Medicine, honorary librarian to the Royal Society of Medicine for many years, and honorary fellow of this Society in 1940, honorary member of the Pathological Society of Great Britain and Ireland, etc. He also gave many important lectures in connexion with bacteriology.

Bulloch added much to the knowledge of his subject, and the more important of his published works covered such subjects as tuberculosis, bacteriological filters, studies in pathology, hæmophilia (with Fildes) in the "Treasury of Human Inheritance", the sterilization of catgut and diphtheria—its bacteriology, pathology and immunology, with others for the Medical Research Council.

I first met Bulloch some thirty-five years ago when a student. In the course of conversation I mentioned that I was about to go abroad to study, and he at once furnished me with the necessary introductions; the latter, as all friends of Bulloch know, acted as a magic charm to the portals of the great masters. Later, when I went to work in his Department at the London Hospital, I learned much of the man and his ideals. Bulloch was extremely conservative; in his own mind only the written word was authoritative, and us younger men he regarded somewhat as Bolsheviks in our views and methods. Thus some new procedure of technique we had devised or adopted would call forth the remark, "such methods are enough to make Pasteur and Koch turn in their graves". Yet in spite of this expression of doubt as to the success or usefulness of our investigations he would, a morning or two later when he came in for a friendly chat, present us with the latest literature on the subject of our research. The same interest in our progress was continued even when we had passed on from his Department. This generous disposal to us of his wide and accurate knowledge was in strong contradiction to his lack of interest in teaching medical students, which to him was of the nature of a necessary evil.

Perhaps Bulloch's outstanding characteristic was his highly developed critical faculty, at times devastating and even a little cruel when directed against imperfect or inaccurate work, only equalled by his intolerance of intrigue and advertisement. In his earlier days woe betide those who failed to come up to his standard, either in their writings or at a scientific meeting. But those who worked for him, even though his criticism was sometimes irritating, learned much that was to prove the foundation of their later successes.

Though brusque in manner, at home Bulloch was a genial and kindly host and liked to give play to his favourite hobby, the study of the frailties of the great men of his subject and of his immediate and humble associates. This gave him a fund of very amusing stories which he loved to recount with a clever mimicry, worthy of Coquelin himself, as a

French man of science once remarked. For this reason afternoon tea in the laboratory was a feast of wit and humour not to be missed. Strange to say, in spite of his cynicism, he was definitely a hero worshipper, and they were many and varied.

Bulloch had a prodigious memory and could give accurate references as to where and when most of the important papers on bacteriology had appeared. He had undoubtedly great influence in raising the standard of bacteriology in Great Britain to its present high level. Though his later years were clouded by long illness, he carried on to the very end his intense interest in all that pertained to bacteriology. Even the London 'Blitz' and the obliteration of the houses next door could not daunt him, as a recent letter I received from him, in the familiar purple ink, showed. We who had the privilege of working under him will long remember his ideals, his wit and his cheerfulness, and bear in our minds the picture of that short sturdy figure, with his carefully polished shoes, pipe in mouth, disappearing down the stairs after tea to commence in the library his real interests of the day.

J. McIntosh.

Dr. C. B. Ticehurst

By the death of Dr. Claud Buchanan Ticehurst of Saxon House, Appledore, Kent, on February 17, in a nursing home at Hastings, the science of ornithology in general and the British Ornithologists' Union in particular have suffered a loss which it would be difficult to exaggerate. It will be still more difficult to fill the gap which his death will cause in the publication of the Union's journal—the *Ibis*—of which he had been the successful and zealous editor since 1931. From his youth Ticehurst was what we might call a born field-ornithologist, but it was at Cambridge, where he was an undergraduate studying medicine at St. John's College, that ornithology came to be the leading passion of his life under the happy guidance and encouragement of Prof. Alfred Newton, whose Sunday evening gatherings were an inspiration and a joy to so many, including such famous ornithologists of the old days as Canon Tristram, the Godmans, Sclater, Wolley, Lilford, Gurney, Salvin, Taylor, Eyton, Wollaston and many others. Ticehurst was one of the many young men of those days who received, so to speak, the accolade; and had it not been for the strenuous calls on a country practitioner's time there can be little doubt that he would have risen to the highest level of ornithological fame.

As it was he established an international reputation, and not only found time to conduct the editorial business of the *Ibis*, only possible by constantly sitting up until the early hours of the morning, but also by clever manipulation of his scanty holidays found it possible to visit such countries as Norway, Portugal, Spain, the Balearic Islands, Holland, France, Yugoslavia, Albania, Egypt and Algeria; to say nothing of the important work he did in India when serving in the R.A.M.C. in the War of 1914–18. In all these countries he made collections of birds with the object of studying plumage changes, geographical distribution and migration. He also published papers in various scientific journals on the birds of Mesopotamia, Sind and Burma; was the author of one of the best county avifaunas—"The Birds of Suffolk"—and proved his sterling merit by writing a monograph on the willow-warblers (Phylloscopi) for the British Museum.

His untimely and much deplored death at the early age of sixty interrupted the work which he was carrying out in conjunction with Mr. Hugh Whistler on the birds of India, Burma and Ceylon.

Following in his father's footsteps, Ticehurst was a very skilful dry-fly fisherman; and by his death, if I may introduce a personal note, I lose a beloved and cheery companion by the banks of the Test. He was never so happy as when tempting (and quite successfully) the rather sophisticated inhabitants of that famous chalk stream (and the Kennet) with his father's self-tied flies, many years old as they were. Some of them had seen such long and faithful service that I think I must have known them by sight.

Percy R. Lowe.

We regret to announce the following deaths:

Prof. F. M. Andrews, professor of botany in Indiana University, on November 26, aged seventy.

Dr. James Balfour, F.B.A., the well-known economist, on January 18, aged eighty-eight.

Mr. M. R. Campbell, formerly principal geologist of the U.S. Geological Survey, on December 7, aged eighty-two.

Sir Charles Fielding, K.B.E., director-general of food production during 1918–19, on April 9, aged seventy-seven.

Prof. W. W. Ford, emeritus professor of bacteriology in the Johns Hopkins University, on February 10, aged sixty-nine.

Prof. W. C. Graustein, professor of mathematics in Harvard University, on January 22.

Prof. J. E. Guberlet, professor and member of the staff of the Oceanographic Laboratories of the University of Washington, aged fifty-four.

Mr. S. Henshaw, emeritus director of the Harvard Museum of Comparative Anatomy, on February 5, aged eighty-nine.

Prof. F. C. Jordan, professor of astronomy and director of the Allegheny Observatory, Pittsburgh, on February 15, aged seventy-five.

Dr. G. W. C. Kaye, O.B.E., F.R.S., superintendent of the Physics Department, National Physical Laboratory, on April 16, aged sixty-one.

The Right Hon. Lord Stamp, G.C.B., G.B.E., F.B.A., aged sixty, and Lady Stamp and the Hon. Wilfred Stamp, during a recent air raid.

Dr. J. P. Sutherland, emeritus dean of the Boston University Medical School, on January 24, aged seventy-four.

NEWS AND VIEWS

Agricultural Research Council: Sir Edwin Butler, C.M.G., C.I.E., F.R.S.

CHARGED as it was with the scientific supervision of the widespread organization for agricultural research which has been developed in Great Britain since 1911 and holding (as many may think unfortunately) but few of the purse strings directly, the policy of the Agricultural Research Council has been to guide and stimulate work in progress at research institutions, rather than to attempt control. As the late Sir William Hardy expressed it, "free" not "directed" research was what it desired to promote. In giving effect to this policy, Sir Edwin Butler proved himself an ideal secretary. An acknowledged leader in his own subject, mycology, he had, as director of institutions in India and Great Britain, gained a wide knowledge of the problems and the methods of the agricultural investigator. He quickly made himself familiar with the work of the research institutes and he visited them frequently. Nor was he ever an unwelcome visitor, since directors and members of staff alike soon found that in him they had a real friend, always ready to interest himself in their problems, always ready with helpful suggestions. To the Council the contacts thus established were invaluable, as were also his detailed descriptive reports. His conclusions could be accepted with confidence; they were marked by proofs of full understanding, careful weighing of evidence and absolute fairness. His personal qualities made him the best of colleagues and it was with great regret that, because of the verdict of his medical advisers, his resignation from the secretaryship was accepted. But this did not come until he had left behind him a permanent memorial of his tenure of office.

When, in 1935, Sir Edwin became its secretary, the Council was searching for a suitable estate on which to establish a field station for experimental work on farm animals; a number of estates was visited and when Compton was seen, Sir Edwin was the first to recognize its possibilities. After it had been acquired its development owed much to him, in particular the fine range of laboratories, and the homes for laboratory animals are largely the result of the care which he, in consultation with Mr. Dunkin, the director, bestowed on the planning of details. Members of Council and others who visit Compton in future must always associate these buildings with the name of Sir Edwin Butler, who watched over their construction from foundation to completion with unceasing care.

Prof. W. W. C. Topley, F.R.S.

PROF. W. W. C. TOPLEY, who now becomes secretary of the Agricultural Research Council, like his predecessor, holds a medical qualification, and like him decided to work for the advancement of science, rather than follow a professional career; but whereas Sir Edwin chose plant pathology as his special subject, it was on science as affecting animal health that Prof. Topley specialized. His name until now has been so closely associated with bacteriology in relation to human medicine that surprise may be felt by some to find him among the agriculturists. But he does not come among them as a stranger. Since the earliest days of the Agricultural Research Council, Prof. Topley has been a valued member of some of its committees on animal health. In 1939 he became a member of Council and he is chairman of the committee in charge of the particular investigation for which the Compton Field Station was, in the first instance, acquired.

It was with great pleasure that his colleagues learned recently that Prof. W. W. C. Topley was willing to accept the post vacated by Sir Edwin and that his qualities of initiative, drive, clear thinking and direct, convincing manner of speech when advocating a cause in which he believes have now been secured for agriculture. In the uncertain days which lie ahead, it is a comforting thought for all who have the progress of agricultural research at heart to know that as its Secretary the Council has secured the services of a man who has not only made outstanding contributions to science, but has also proved himself to be an inspiring leader of others. It may be that those primarily interested in medicine may regret Prof. Topley's decision, but let them not forget that in recent years it has become increasingly clear that the foundations of human health are deeply laid, that man's physical well-being depends in no small degree on the health of domestic animals, on the properties of cultivated plants, and ultimately indeed on the special characteristics of the soil itself. Medical science will not lose, but gain, by Prof. Topley's transference to the wider field of agricultural science.

Centenary of the Pharmaceutical Society

IN the afternoon of April 15 several hundreds of pharmacists attended a meeting at Conway Hall, Red Lion Square, London, which was held to celebrate the centenary of the Pharmaceutical Society. Mr. Walter Deacon, who presided, introduced Sir John Anderson, Lord President of the Council who, he said, now had many dealings with representatives of the Society at the Home Office and elsewhere. In his address, Sir John said it was fitting that someone with a knowledge of the circumstances of pharmacy extending over thirty years should attend the meeting as a representative of His Majesty's Government to pay tribute to the Society's past achievements and to wish it well for the future. The founders of the Society, he continued, laid down that its main purpose should be to advance chemistry and pharmacy, and the constancy with which their successors had pursued that aim deserved the fullest recognition. Modern developments of medicine have changed completely the work of the pharmacist, and it is right that the public should now know how successful have been the efforts of the Pharmaceutical Society to keep in line with the advance in knowledge and the great progress of medical science. A play, "Jacob Bell and Some Others", specially written for the occasion by Mr. H. N. Linstead, secretary of the Pharmaceutical Society, and produced by Donald Wolfit, followed the speeches. It brought vividly to the large audience episodes associated with the Society's foundation.

Haricot Beans

At the request of the Ministry of Agriculture the Imperial Bureau of Horticulture and Plantation Crops, East Malling, has issued a bulletin compiled by G. St. Clair Feilden, on haricot beans (Occasional Paper No. 6. 1*s*.). Hitherto cheap supplies of beans from North America, Japan and Hungary have discouraged farmers in the United Kingdom from embarking on a crop that proves only fully successful in a dry summer. In war-time, however, it seemed advisable to re-examine the possibility of providing such a valuable addition to the nation's food, and yields of one ton or more per acre were obtained in trials made in 1940. The bulletin contains a brief account of work with haricots in the United States and Canada and of the results of experiments in England at various centres. Cultivation is outlined and harvesting and cooking methods are described. The varieties at present available, though they did well in England in 1940, are really more suited to warmer and drier climates, and it is to be hoped that some growers will become sufficiently interested to hybridize and select strains that are more dependable to ripen a full crop in Great Britain.

War Fellings and Insect Pests

In the *Scottish Forestry Journal* (54, Pt. 2, Oct. 1940), Dr. A. E. Cameron, of the Department of Entomology, University of Edinburgh, writes on "The Effect of Felling on the Incidence of Forest Insect Pests". The many fellings throughout Britain during the War of 1914–18 and the remnants left on the ground for several years thereafter were the breeding places of large numbers of some of the more dangerous of our insect pests, which afterwards spread destruction in young, middle-aged, and old woods throughout the country. Once again we are faced with a similar emergency, and the same aftermath of the fellings is to be seen on many a site of a former wood, now felled for war purposes. The insect pest question, as Dr. Cameron says, is likely to be acute in the near future unless attention is given to it, and some effort made to counter its possible or certain virulence. The author practically confines himself to conifers and their chief pests. But in parts of Great Britain there is an equal danger to some of the valuable hardwoods, including oak, ash and elm, to mention three only. But since the major part of the afforestation work of the Forestry Commission is connected with the conifers, the question of this possible insect danger is greater now than it was in 1918, when there was a comparatively small area of young conifer plantations in the country.

Dr. Cameron deals with the different types of forest and their respective immunity or otherwise. He says that our only indigenous conifer, the Scots pine, is the most-subject to attack by several species, but that the other conifers, exotics, such as spruce, Douglas fir and larch are subject. The chief dangerous pests are the weevils, *Hylobius abietis*, *Pissodes notatus* and *P. pini*, and the pine beetles, *Myelophilis piniperda* and *M. minor*, *Hylastes ater* and *Pityogenes bidentatus*. In order to combat these pests, Dr. Cameron states that their habits must be known intimately, and then some measures of control which he details may be instituted.

Anthropological Observations in New Guinea

Information relating to the work of an expedition of anthropological, ethnographical and linguistic investigation in the little-known north-eastern region of New Guinea under the leadership of Dr. Georg Höltker is given by Dr. Otto Schlaginhaufen in the current issue of the bulletin of the Swiss Anthropological and Ethnographical Society (*Bull. Schw. Gesell. f. Anthrop. u. Ethnol.*, 16, 1940). The expedition, which had recently returned at the time of writing, was in the field for the three years 1936–39. Its operations covered the coastal region south-eastwards from the mouth of the Sepik River, and the coastal and inland territory on the east side of the lower waters of the Ramu River, and country in the basin of the Mbur, a tributary of the Ramu, as well as islands of the coast including Manam and Dampier. Of the peoples under investigation by the expedition a proportion were classifiable linguistically as belonging to the Melanesian stock, but the greater number were Papuan. Anthropological observations were made by Dr. Höltker on members of the former group on the mainland—Sepa and Wanami living to the south of the coastal peoples of Monumbo (Potsdamhaven) and on the islands. The Papuan group examined included the Bosgung on the Mbur, Watum to the south of the Sepik and among inland peoples, Tanggum, Ariaw, Mikarew, Dinam and Akekom. Observations were made on 1,685 individuals, both adults and children.

Earthquake in Mexico

A severe earthquake shook more than 20,000 square miles of territory in northern Mexico on April 15, causing much damage to property, and, it is feared, a heavy death roll. Full details are as yet lacking, but preliminary facts may be given. The States most affected were Aguascalientes, Colima, Guanajuato, Jalisco, Mexico, Michoacan, Puebla and Tlaxcala, the isoseismals apparently being elongated in an east-west direction. The epicentre may have been in the neighbourhood of Chilpancingo, though very great damage was done to the city of Colima, capital of the State of Colima, 275 miles west of Mexico City. In Colima the homes of approximately 10,000 people have been reported destroyed. There were damage and loss of life also at other towns, including Guadalajara and Manzanillo, and as far east as Maltrata in the State of Vera Cruz. Mexico

City was only slightly affected. At the same time, the volcano near Colima erupted, setting fire to forests. These fires further threatened Colima.

Recent Earthquakes recorded at Kew

FOUR large earthquakes have been recorded at Kew in the period March 23 – April 13. The first was received at 22h. 41m. 17s. G.M.T. on March 28 and may have been from an epicentre 19,000 km. distant, though the initial movements were confused by microseisms. The second was at 10h. 52m. 19s. on April 1, probably from an epicentre 7,870 km. distant, while the third, at 15h. 34m. 31s. G.M.T. on April 3, had its epicentre 9,180 km. away. This latter had a particularly prominent wave on all three components at 15h. 33·5m. G.M.T., which may have been *eSSS*. An earthquake giving a full suite of pulses had *iP* dilatational at 23h. 40m. 27s. G.M.T. on April 7 and did not cease recording until 3h. 20m. G.M.T. on April 8. It probably had its epicentre 7,920 km. distant from Kew, though all calculated epicentral distances are tentative.

Canadian Polar Year Expeditions

THE first volume of a work which describes the observations carried out by the Canadian Polar Year Expeditions, 1932–33, is largely statistical; but there is a general introduction by Dr. J. Patterson, the director of the Canadian Meteorological Service, and notes on the instruments at the Expeditions' four stations—Cape Hope's Advance, Chesterfield Inlet, Coppermine and Meanook, together with maps and photographs (Dominion of Canada: Department of Transport, Air Services Branch, Division of Meteorological Services of Canada. Canadian Polar Year Expeditions, 1932–33, Meteorology: Cape Hope's Advance, Chesterfield Inlet, Coppermine, Meanook. Vol. 1. Pp. xvi + 443 + 46 plates. Ottawa: King's Printer, 1940). Meanook (Alberta) is a permanent magnetic station—the nearest to the north magnetic pole—the other three stations were temporarily set up for this undertaking. The statistical matter which, as has already been mentioned, occupies a very large proportion of the volume, consists mainly of hourly values of atmospheric pressure, temperature, humidity, precipitation, sunshine and wind velocity, to which are added full particulars of the upper winds revealed by numerous observations with pilot balloons, and notes on optical phenomena. The period covered—August 1932–September 1933—is long enough to illustrate the inhospitable climate of these regions, with frequent gales and strong winds, and a long and severe winter. The complete absence of trees, and even of bushes, worthy of the name, at the more northerly stations needs no other explanation.

At Coppermine, pilot balloon observations were supplemented by seventy-four soundings with kites carrying Marvin meteorographs lent by the U.S. Weather Bureau, but the results do not appear to be given in this volume. The same station was supplied with several Patterson flashing-lamp balloon meteorographs. This is a very light form of meteorograph which indicates pressure and temperature by the lighting up of a string of electric bulbs suspended by a silk cord beneath the balloon, an observation consisting of the identification of the bulbs shining at a particular moment. Graphs of temperature observations up to 2 km. obtained in this way in March 1933 are given, all of which show at least one inversion or disappearance of lapse of temperature with height, below 1 km. At Meanook, the most southerly of the four stations (54° 37′ N.), noctilucent clouds of the kind described by Størmer were observed on the night of July 20–21, 1933, at a height exceeding 55 km. This appears to be the first occasion on which such clouds have been noted in America.

A Plastic for Thermal Insulation

IN the electrical industry cellulose acetate is widely used in both sheet form and as mouldings. A multilayer insulating material, made from cellulose acetate, and known as 'Isoflex', is described in the *Electrician* of March 7. Isoflex is manufactured from cellulose acetate film and in structure is not unlike corrugated cardboard used for packing purposes, with about five layers to each inch of thickness. It has a thermal conductivity of 0·32 B.TH.U. per hour per sq. ft. per in. thickness per 1° F. difference of temperature, so that its insulation properties compare very favourably with slab-cork (0·25 B.TH.U.), glass-fibre (0·28 B.TH.U.) and wood fibre board (0·38 B.TH.U.). Its volume weight of 0·75 lb. per cu. ft. works out at about one-tenth that of slab-cork. This makes it of considerable interest in connexion with thermal insulation during transport.

Isoflex is non-porous and non-absorbent, with the result that its thermal insulation is not impaired by the deposition of moisture in the material. Its construction in the tubular form allows free draining of condensed moisture. From the constructional point of view it is very easy to handle, as it can readily be cut by a knife. It will withstand wear and tear, and it does not disintegrate under the severe vibration of a railway coach; it is inert to salt water, thus making it suitable for marine work. It will not ignite or burn by itself, and therefore its installation does not result in an increase in the fire risk. However, it melts at about 175° C. and it is not suitable for heat insulation at temperatures which exceed 75° C. Isoflex is available in two types of slab. One type, known as the standard slab, is 24 in. square and is rigid; the other, the flexible slab, measures 23 in. × 20 in. By cutting one or other of these slabs, and by using a combination of them, any desired shape can be built up without difficulty.

Electric Supply in Churches

THE eighth report of the Central Council for the Care of Churches includes a timely memorandum for the guidance of parochial authorities about to install new lighting apparatus, and a series of regulations to be observed by contractors. In a preface to the regulations is a statement that the work must comply with the regulations of the Institution of

Electrical Engineers. Cables must be rubber- or paper-insulated and must be run in heavy-gauge solid-drawn galvanized-welded screw conduit (preferably) or in heavy-gauge welded screw conduit. Alternatively, 'Pyrotenax' may be employed. Attention is directed to a modification of an electric soldering iron for heating sealing compound, which enables joints to be made on the spot instead of entailing removals to a bench for heating with a blow lamp, in order to avoid risk of fire where timber is adjacent.

Cables of the supply undertaking should be taken into the building for as short a distance as possible and run only on brick or stone walls. Distribution boxes and fuses must be in cast iron cases. Instrument panels should be well clear of walls and should be of slate or other non-inflammable material; if of wood, only teak may be used. The wiring of ancient brass candelabra is condemned, as it would be almost impossible to remove the detachable brasses for cleaning. Electroliers or fittings must be hung on chains and their weight must not be borne by electric cables or flexible cords. All reachable metal work is to be earthed. Any relay or other circuit carried to a switch at an organ keyboard for starting a blower must be run in screwed conduit or be of 'Pyrotenax'; the starting switch must be in a metal case mechanically and electrically continuous with the circuit and with the approved earth connexion.

American Philosophical Society Publications

The American Philosophical Society has issued a list of books and papers in the Society's publications from 1769 until 1940 classified according to subject. This covers the papers, monographs, treatises and books, classified according to subject, and includes a subject index as well as a classified list, an author index and a price list. The *Transactions* of the Society is the oldest scientific journal with a continuous history in the United States, commencing in 1769; the six volumes issued in small quarto format up to 1809 are known as the "old series" and are out of print except for a few numbers. A new series was started in the present large quarto format in 1818, and to date thirty-one volumes have been issued.

The *Proceedings*, commenced in 1938, contain the original papers read before the Society as well as others accepted for publication. In view of the interest and value of some of the early material to the research student and historian, certain abstracts of papers read before the Society, verbal communications, letters on scientific and learned subjects, etc., included in the early *Proceedings* have been reproduced in the list. The *Memoirs*, commenced in 1935, consist of monographs and books each constituting a separate volume of the series, of which fifteen volumes have now been issued. In addition to its serial publications, the American Philosophical Society has published or sponsored for publication a number of separate works which are listed under "Miscellaneous Publications". Its library also maintains a photo-duplication service for supplying 35-mm. microfilm copies of out-of-print articles and manuscript material. Printed books are copied at the rate of 3 cents per standard frame, usually 2 pages per exposure. Manuscript is copied at the rate of 4 cents, usually 1 page, per exposure.

The Night Sky in May

The duration of night (sunset to sunrise) decreases from 9·3 hours on May 1 to 7·7 hours on June 1 in the latitude of London. Full moon is on May 11 and new moon on May 26. No bright star is occulted by the moon during the month. There is a general absence of bright planets in the night sky of this month. Jupiter and Saturn are now too near the sun for observation. Towards the end of May, however, conditions are favourable for seeing Mercury in the low western sky after sunset. In mid-May, Mars is nearly 5° above the eastern horizon soon after 3h. 30m. U.T., but sunrise is shortly after 4h. (add 2 hours to convert to new Summer Time). About this date the following constellations are near the southern meridian at dusk: Ursa Major, Canes Venatici, Coma Berenices, Bootes, Leo, Virgo, Crater, Corvus and Hydra. Pleasing in its symmetry is the formation of seven stars of medium brightness in Corona Borealis. A nova appearing near ε Coronæ Borealis in 1866 added to the lustre of this 'crown'.

University of Birmingham: Air Raid Damage

In a recent air raid, many bombs fell in the grounds of the University of Birmingham, and the chemistry buildings were hit. Fortunately, very little damage was done.

Civil List Pensions

A list of the pensions granted during the year ended March 31, 1941, and payable under the Civil List Act, 1937, has recently been issued. Among them are the following: *New Pensions:* Mrs. Mary Browne (services of her husband, the late Dr. Charles Browne, to anthropology), £100; Dr. C. C. Hurst (discoveries in science of genetics and their application to agriculture, horticulture and sociology), £130; Sir Alfred Matthews (services to agriculture), £150; *Supplementary Pensions:* Mrs. Jessie Bennett (services of her husband, the late Mr. Arthur Bennett, to botanical science: additional to £60), £40; Miss Fanny Bryant (services of her father, the late Mr. Thomas Bryant, to surgery: additional to £30), £70; Mrs. Barbara Kaye (services of her husband, the late Mr. Walter J. Kaye, to archæology: additional to £60), £40; Mrs. Johanna Miller (services of her husband, the late Dr. N. H. J. Miller, to agricultural science: additional to £50), £50; Miss Eleanor S. Sowerby (botanical works of her father, the late Mr. J. E. Sowerby: additional to £50), £50; Mrs. Elsie V. Sullivan (services of her husband, the late Mr. J. W. N. Sullivan, to literature: additional to £75), £25; Miss Helen S. Tichborne (scientific discoveries of her father, the late Prof. Tichborne, in chemistry and pharmacology: additional to £60), £40; Mrs. Ada E. Scott (services of her husband, the late Mr. Andrew Scott, to zoological science: additional to £80), £30.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Ionization Maximum for Protons

IN a recent paper, Holloway and Moore[1] have given a curve showing the average specific ionization, as a function of the residual range, for protons in air. On this curve the ionization maximum occurs at 1·9 mm. residual/range, and in the course of the paper the absolute value of the maximum specific ionization is quoted as 2,320 ion pairs per mm. The shape of the ionization/range curve was deduced from earlier measurements of Parkinson, Herb, Bellamy and Hudson[2], and the absolute value of the ionization was obtained on the assumption that, in the region of 3 cm. residual range, the mean specific ionization produced by a proton is a quarter of that produced by an α-particle of the same velocity. On this basis Holloway and Moore inferred that the maximum specific ionization is about one third as great for protons as for α-particles in air (6,760 ion pairs per mm.). Now, while there is overwhelming evidence for the correctness of this last assumption (the 1 : 4 ratio of ionizations for particles of the same velocity, when the ratio of the effective charges is constant at 1 : 2), it also appears that the conclusions, regarding the position and height of the ionization maximum for protons, to which the subsequent argument leads, run contrary to accepted evidence from other experiments. If this be admitted, then one must clearly assume that the results of Parkinson, Herb, Bellamy and Hudson will not bear the detailed analysis which Holloway and Moore place upon them, when protons of the smallest energy are concerned. It is the object of the present note to point out the contrary evidence referred to above.

As regards the position of the ionization maximum, the situation is relatively simple: this has been determined by Bower[3] from observations of the light scattered by cloud tracks of protons in a mixture of helium and air. Bower found a maximum in the scattered-light/distance curve at a point corresponding to 0·8 mm. residual range in standard air. While the method is quite different, and the definition of the end of the range not necessarily the same as in ionization chamber experiments, the discrepancy (0·8 as against 1·9 mm.) is greater than can be explained by such considerations. It can only be resolved by assuming that the velocity at which electron capture by protons becomes appreciable is much less in helium than in air. On the other hand, if we are to accept an increase in the assumed value of the maximum ionization (*v. inf.*), then the suggestion of a lower effective charge over the last few millimetres of residual range in air is clearly unwarrantable.

There are two distinct lines of evidence concerning the absolute value of the maximum specific ionization by protons which Holloway and Moore do not mention in the paper under discussion. In the first place, the experiments of Parkinson, Herb, Bellamy and Hudson provide some information which has still to be considered. In the α-particle case Holloway and Moore deduce the energy/range relation, for small values of the residual range, by integrating the differential specific ionization curve of Holloway and Livingston[4] and assuming a constant value for the average expenditure of energy per ion pair, for α-particles of all ranges. With protons, however, they deduce the shape of the differential ionization curve from the results of Parkinson *et al.*, while these results, in themselves, are believed to express the energy/range relation down to the smallest energies. Normalizing the differential curve against the corresponding curve for α-particles, as already described, Holloway and Moore obviously assume the same energy loss per ion pair for the two particles at high energies, yet for low energies a comparison of their differential-ionization/range and energy/range curves shows an apparent rapid increase of this mean energy loss for protons, as against the assumed constancy of this quantity for α-particles. Over the last 2–3 mm. of path, the energy/range relation gives an average rate of loss of energy almost exactly 10^5 ev. per mm. for protons in air (see Bethe[5]); if the differential ionization curve of Holloway and Moore were correct in this region, an expenditure of about 53 ev. per ion pair would be required. To set against this conclusion, for protons of about 8 mm. air range, a direct determination by Stetter and Jentschke[6] gave 32·6 ± 1·6 ev. per ion pair (in deuterium), compared with the accepted value of 33 ev. for α-particles of some cm. range.

The second line of evidence for a higher ionization maximum for protons derives from experiments on the photo-protons produced in deuterium by the γ-rays of thorium C''. Rogers (F. T.) and Rogers (M. M.)[7] have determined the mean energy of these protons as $(2{\cdot}25 \pm 0{\cdot}15) \times 10^5$ ev. from experiments with a cloud chamber in a strong magnetic field. Direct determinations of the mean number of pairs of ions produced by the photo-protons in deuterium have been made by Chadwick and Goldhaber[8] (7,200 ± 1,000) and, more accurately, by Stetter and Jentschke[6] (6,650 ± 200). From the measurements of Chadwick, Feather and Bretscher[9], Bethe[5] has calculated the mean air range as 2·28 mm. From these figures, again, the average expenditure of energy per ion pair in deuterium is 33·8 ± 2·6 ev., the same as for high-energy α-particles, and, if one takes this value for protons in air also (for high-energy α-particles the energy loss per ion pair is almost exactly the same in air as in hydrogen) then the mean ionization per mm. due to protons in air (over the last 2·28 mm. of path) is 2,900 ± 230 pairs of ions. If this be accepted, the maximum specific ionization cannot well be less than 3,400 ion pairs per mm.—or one half, rather than one third, of the maximum specific ionization due to an α-particle.

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March 21.

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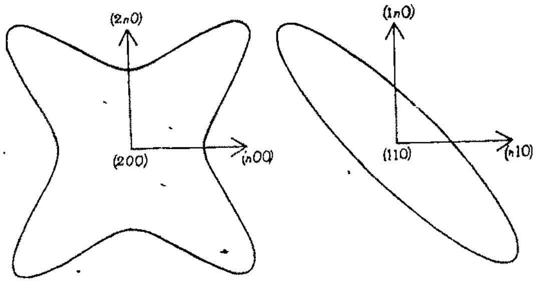
Diffuse Reflexion of X-Rays

IN a recent note Preston[1] has commented upon the agreement of his experimental results for the diffuse scattering of X-rays by single crystals of aluminium with the predictions of both the Preston–Bragg block hypothesis and a formula derived by Faxén. It seems necessary to correct the impression which might thereby be formed that the Preston–Bragg hypothesis is reconcilable with the Faxén–Waller theory. This is indeed not the case. It has been shown by Laue[2] that if the intensity of scattering from a finite crystal is plotted in the reciprocal lattice space as a function of the end-point of the vector $\vec{S} = \frac{\vec{\varepsilon} - \vec{\varepsilon}_0}{\lambda}$ (ε_0, ε unit vectors in the direction of incident and reflected ray, λ wave-length) drawn from the origin of the reciprocal lattice, then the resulting distribution of scattering power is periodic with the periods of the reciprocal lattice, so that in particular there is the same distribution about every reciprocal lattice point. On the other hand, the Faxén formula discussed by Preston is obtained by specialization (see below) from a general expression derived by both Faxén[3] and Waller[4] for the first approximation to the coherent diffuse scattering from a monatomic cubical crystal. This general expression can be written in the form:

$$I \sim \frac{(\vec{S}, \vec{A}_1)^2}{\nu_1{}^2} + \frac{(\vec{S}, \vec{A}_2)^2}{\nu_2{}^2} + \frac{(\vec{S}, \vec{A}_3)^2}{\nu_3{}^2},$$

where $\vec{A}_1$, $\vec{A}_2$, $\vec{A}_3$ are unit (and orthogonal) vectors defining the directions of oscillation of those three acoustical vibrations the wave vector $\vec{w}$ of which satisfies the Faxén-Waller vector condition (namely, $\vec{w} = \vec{S} - \vec{B}$, where $\vec{B}$ is that reciprocal lattice vector the end-point of which lies nearest to that of $\vec{S}$) and ν_1, ν_2, ν_3 are the respective frequencies of these vibrations. Owing to the occurrence in this expression of the cosines of the angles between the vector $\vec{S}$ and the vectors of oscillation, it is clear that the expression must lead to a different distribution of scattering power about each point of the reciprocal lattice. In a paper which I have in preparation, the general Faxén–Waller expression has been evaluated for various relative values of the three elastic constants c_{11}, c_{12}, c_{44} of a cubic crystal, and the marked dependence of the scattering power upon the elastic anisotropy demonstrated. For example, for sodium single crystals, using the values of the elastic constants determined by Quimby and Siegel[5], namely, $c_1 = 0{\cdot}760\ c_{11}$, $c_{44} = 0{\cdot}914\ c_{11}$ (at 200° K.), with cubic anisotropy $c_{11} - c_{12} - 2c_{44} = -1{\cdot}59\ c_{11}$, the section of the contours of isodiffusion of the 200 and 110 reflexions in the 200,020 plane of the reciprocal lattice approach, in the limiting case of long elastic waves, that is, proximity to the Bragg spot, the shape shown in the accompanying diagram.



THEORETICAL CURVES OF ISODIFFUSION FOR SODIUM SINGLE CRYSTALS.

Experiments to test the existence of these different distributions about different Bragg spots are being carried out in this Laboratory, although it should be pointed out that the earlier work of Laval[6] gives clear indication that these differences do exist in the manner required by the Faxén–Waller theory.

The special assumptions made by Faxén in arriving at the simple formula discussed by Preston included that of spherical isotropy for the elastic properties of the cubical crystal, namely, the relation $c_{11} - c_{12} = 2c_{44}$, which condition is fairly closely satisfied by aluminium ($c_{12} = 0{\cdot}57\ c_{11}$, $c_{44} \doteq 0{\cdot}26\ c_{11}$, $c_{11} - c_{12} - 2c_{44} = -0{\cdot}09\ c_{11}$); consequently the differences here will be less marked and more difficult to determine.

It should be stressed that we have in the diffuse scattering phenomenon a much finer method of exploring the vibrational spectrum of a crystal than is possible by studying, for example, the specific heat or the Debye–Waller factor; for whereas there one is dealing with averages over all directions of propagation of the elastic waves, here, in the diffuse scattering for a given crystal setting and direction of scattering, only those vibrations the wave-lengths and directions of propagation of which lie within restricted limits contribute to the scattering (Faxén–Waller vector condition).

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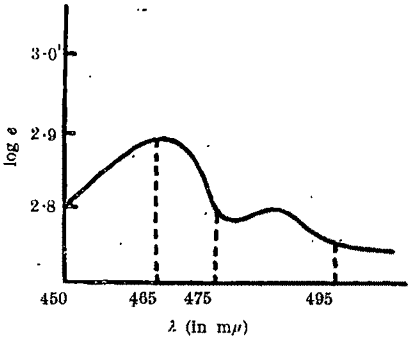
Formation of Ions from Compounds with Conjugated Double Bonds: Hydrocarbon Salts

IT has been suggested previously[1] that any system containing conjugated double bonds should be capable of forming ions, particularly positive ions. This holds not only in the case of carbon-carbon bonds (aliphatic or aromatic) but also in systems containing, for example, nitrogen, oxygen, sulphur, which, like carbon, can supply mobile π-electrons (double-bond electrons) which are essential for the 'metallic' behaviour of these compounds. Particular interest is attached to the hydrocarbons with conjugated rings, to which group the carcinogenic hydrocarbons also belong.

I have now succeeded in preparing various salts from these hydrocarbons such as coronene, 1 : 2 benzperylene, 3 : 4 benzpyrene, and anthracene with different acids (perchlorate, sulphate, pyrophosphate) as anions. As indicated earlier[1] these salts are formed from the hydrocarbons by an oxidizing agent, such as a chromium trioxide, potassium ferricyanide or hydrogen peroxide, in the presence of the fairly concentrated strong acids at room temperature. Many of these hydrocarbons are oxidized even by molecular oxygen, yielding the same oxidation products. The sulphates are more difficult to prepare because conditions must be found where no appreciable sulphonation of the hydrocarbons takes place. However, it seems that deeply coloured (water-soluble) salts are formed even from the sulphonated hydrocarbons.

The perchlorate of anthracene is the lowest of the series which has been prepared so far. It shows some of the characteristic properties of these new compounds, which are given in the following :

Anthracene perchlorate, $[C_{14}H_{10}]^{+}[ClO_4]^{-}$. Found: C, 60·9; H, 3·2; Cl, 12·5; $C_{14}H_{10}ClO_4$ requires C, 60·6; H, 3·6; Cl, 12·8 per cent; dark brown fine crystals, recrystallized from acetone-methyl alcohol (1 : 1) decomposes before melting above 110°. Very soluble in acetone with deep brown colour (absorption spectrum, see below). The solutions in acetone are good conductors of electricity. Electrolysis takes place and a deposit is formed at the cathode. Also soluble in ethyl alcohol and benzene. Whereas the salts of the higher molecular hydrocarbons are stable in the presence of water, anthracene perchlorate is decomposed by water, particularly in solution. The perchlorates are all easily decomposed by heat.



ABSORPTION SPECTRUM IN THE VISIBLE REGION OF ANTHRACENE PERCHLORATE IN ACETONE SOLUTION.

The deep colour of the solutions is due to the positive hydrocarbon ion, as is to be expected on theoretical grounds. Under the conditions studied, monovalent ions have been observed ([hydrocarbon]+ [anion]−), although the formation of divalent hydrocarbon ions does not seem unlikely in certain cases.

We have further been led to investigate the structure of the well-known hydrocarbon polynitro compounds (for example, hydrocarbon picrates). These compounds have hitherto been regarded as 'polarization aggregates', although Hammick[2] and Gibson and Loeffler[3] have already suggested that an 'electronic shift' takes place in the case of the corresponding amino compounds. On the basis of the above considerations, we have come to the conclusion that these deeply coloured polynitro compounds are present to an appreciable extent as ionic compounds of the general formulæ : [hydrocarbon]+[nitro compound]- and [amino compound]+ [nitro compound]- in those cases were the molecular ratio is 1 : 1 or as divalent ions ; for example, [hydrocarbon]++ [nitro compound]$_2^-$, where the molecular ratio 1 : 2 prevails. This explains their deep colour, and the rates and mechanism of their formation and decomposition, and is compatible with the observed heats of formation.

The crystal structure of these compounds and the crystallographic distances (3–3·5A.) between their constituents can now be easily explained on the basis of ionic crystals of a somewhat salt-like character as discussed above. The sodium chloride type of structure has actually been observed in the system acenaphthene - 2,6-dinitro - 1,3-xylene[4] whereas in many other cases[5] we find the 'layer lattice' type, as is to be expected when the ions differ appreciably in their size and polarizability.[6]

The importance of these ions is not confined to their appearance as intermediate products in various reactions concerning conjugated systems (oxidation, polymerization, etc.) but may open new possibilities in organic synthesis and give a deeper understanding of their biological action.

A full report will be published elsewhere.

I wish to express my thanks to Prof. G. R. Clemo, and Prof. J. W. Cook for valuable discussions and specimens of hydrocarbons.

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VEGETABLES AS FOOD

BY DR. MAGNUS PYKE

THE low mechanical efficiency with which a steam engine converts heat into energy is perennially shocking to each generation of schoolboys, but the wastefulness of the steam engine is nothing compared with the waste of vitamin C which takes place between the time a green vegetable is harvested and its final disappearance from the diner's fork. A cabbage bought at the market may perhaps be expected to contain 60 per cent of its original vitamin C content, the housewife probably throws away no more than 20 per cent of the remainder in preparing the vegetable for the pot, leaving 40 per cent of the original vitamin. During boiling, however, although a negligible proportion is destroyed by the heat, about 65 per cent is extracted by the cooking water and usually thrown away. Thus 17 per cent of the vitamin C with which the cabbage left the field is all that remains when it reaches the table, and if the dish is kept hot before being served even this small residue quickly dwindles to extinction. In 1940, one and a third million tons of green vegetables were produced in Great Britain. From this crop roughly 650,000 kilograms of ascorbic acid, or almost exactly the amount needed to satisfy the physiological requirements of the entire population for a year, was lost.

To the canner it would be thought was presented the opportunity of stopping at least some of these great losses. For him there is the minimum delay between harvesting and processing. The crops are grown to suit him so that loss in preparation for cooking must be small. Cooking, one would think, was inside the tin so that the principal loss by extraction could be avoided. However, the canner, it seems, must do what he should strenuously eschew. He plunges his vegetables for 1½–20 minutes into nearly boiling water before he puts them in their tins and thereby loses the bulk of the vitamin C. Blanching, he calls it, and advances five technological reasons for doing it: but what a pity!

It was at the discussion on April 9 of the nutrition panel of the Society of Chemical Industry on "Vegetables as Food" that these points arose. Miss Mamie Olliver reported one experiment after another of her own unpublished work showing the devastating effect of cooking on the vitamin C in vegetables, and Mr. W. B. Adam concluded that canning affects the nutritive value of vegetables equally as domestic cooking.

Although root vegetables may provide carbohydrate, and green leaves supply protein of useful quality, and although pulses contribute calories, carbohydrate and second-class protein to the diet, vegetables are primarily useful as sources of vitamins A and C and iron and calcium. If the proportions of the day's requirements of each of these four factors in 4 oz. of any vegetable, cooked or raw according to how it is customarily eaten, are plotted one above the other as a column in a graph, a measure of the excellence of the article as a protective food is obtained. A series of vegetables graded in this way and arranged in order of merit is instructive. First come the green vegetables, broccoli tops, watercress, mustard and cress, Brussels sprouts and spinach, rich in carotene, very rich in vitamin C, and containing useful contributions of iron and calcium, although it is doubtful whether the calcium in spinach is utilizable. Next come cabbage and cauliflower, which still contain substantial amounts of vitamin C but negligible quantities of carotene. In green vegetables carotene is associated with greenness; when the heart of a cabbage is blanched it thereby forfeits its rank in the highest class of 'protective' vegetables. Tomato and lettuce fall in the middle of the list. They contain more carotene but much less vitamin C. The vegetables at the bottom of the list, one-fifth as concentrated as the greens, are turnips, green peas, radish, leeks, parsnips, string beans and onions. Asparagus, cucumber, celery and marrow contain so little of vitamins or minerals that they cannot be graded at all.

How does the carrot stand in such company? Carrots contain carotene, but I have presented figures which showed that although 4 oz. of boiled carrot contains as much carotene as the same amount of boiled Brussels sprouts, this was less than half that in spinach, watercress or broccoli. Carrots besides possess a mere 5 per cent of the vitamin C in the green vegetables and a fraction of their available iron and calcium. Even Dr. Leslie Harris, who asserted that the carotene in carrot can equal or excel that in the best green vegetables, cannot thereby promote it to a rank of equality with them in general excellence as a protective food.

The leading vegetable of all those mentioned at the discussion was 'broccoli tops'. McCance, Widdowson and Shackleton introduced the name to the scientific world when they analysed their samples in 1936, but agriculturists, even guided by a botanical designation, found the term ambiguous. Five London greengrocers approached during an interval in the discussion under review produced three different plants identified respectively as 'purple sprouting broccoli', 'white broccoli' and 'winter cauliflower'. Miss Widdowson expressed the belief that none of these was the 'broccoli tops' reported upon in the literature.

In planning war-time vegetable production there is more to do than identify and grow the crops of highest nutritional value. Yield per acre, hardiness and popularity must all be considered. Cabbages which produce heavy crops are tolerated by the public. Brussels sprouts are liked. Although education and shortage can drive people part of the way towards eating what they do not like, palatability is nevertheless important.

Dr. H. V. Taylor showed how war-time vegetable production has been organized to comply with the suggestions of the Scientific Food Policy Committee. A supply of green vegetables has been assured all the year round, the acreage of carrots has been doubled, greenhouses devoted in peace-time to the growing of flowers have been converted to tomatoes and so on. Now, however, the army, the navy, the air force and the general public are insistently crying out for a vegetable product of negligible dietetic value, namely, pickles. In 1941, therefore, it has been decided to plant several thousand acres of land with onions for pickling, with garlic, cauliflower, gherkins, red cabbage and mustard. Will science say that the decision is wrong ?

When the figures are compared side by side, green vegetables are more substantial providers of vitamin C than any fruit except black currant. Thus in war-time they can readily take the place of the oranges and lemons which no longer reach us. According to the analytical figures for carotene, besides supplying the full physiological requirement of vitamin C, green vegetables can also provide all the vitamin A we need. Here is, however, a topic on which further investigation is required. To what extent is the carotene present in each plant physiologically active as vitamin A, and what proportion is absorbed by the body ? Even if only 40 per cent of the carotene present in a 4-oz. portion of watercress is physiologically available, it will still provide 50 per cent of the total daily requirement. In spite of the lack of clear-cut evidence on the vitamin A activity of each vegetable, there are, therefore, grounds for asserting that the full vitamin A needs of the body could be supplied by vegetables should circumstances ever require it.

Besides their importance as protective foods, vegetables could play other minor parts in war-time nutrition. A temporary glut of carrots, for example, if dried would provide palatable carbohydrate. Although perhaps more physiological work is needed on the biological value of green leaf protein, Sir John Russell, from the chair, agreed with the weight of current scientific opinion that its value is high. Preparation of purified vegetable protein might thus provide a valuable addition to the national food supply.

The Society of Chemical Industry's discussion showed that many lacunæ in the knowledge of the nutritive value of vegetables exist. Planning of vegetable production even when guided by scientific advice is a difficult task which may never reach perfection. The crucial rôle of green vegetables is to provide almost alone in war-time the whole dietary requirement of vitamin C. Research on the physiological availability of leaf carotene is not of equal importance. Just as a population is immunized against typhoid for six months or more by a single treatment, so can a country be protected against vitamin A deficiency for a winter by a single dose. The daily requirement of vitamin C, however, must be acquired daily. This is where work, investigation, inspection and analysis at every point must be organized. The Forces equally with the civil authorities must never be satisfied with calculations from a book of tables to insure the nutritional adequacy of food supplies. The men at a mess where the best scientific information had been applied to perfect their diet were found, when submitted to a saturation test, to be grossly deficient in vitamin C. Communal catering tends to increase the times during which dishes are kept hot, a process destructive of vitamin C.

The chemists met the botanists, the dietitians and the administrators to their mutual benefit. The national interest would be served by the further penetration of scientific workers into the market, the communal feeding centre and the canteen.

THE BRITISH PHARMACEUTICAL CONFERENCE

THE seventy-eighth annual meeting of the British Pharmaceutical Conference was held at Conway Hall, Red Lion Square, London, on April 16. With a single day, instead of the best part of a week as in peace-time, the proceedings were severely curtailed, but in addition to the chairman's address, twelve papers were presented at the science session, and although only summaries of them were actually read, the full papers will be available in the official publication of the Conference, in due course. Some of the papers are outlined below.

In his inaugural address as chairman, Mr. A. R. Melhuish dealt with problems affecting pharmacists in their capacity of servants of medicine and servants of the State. He spoke, to use his own phrase, as "a workaday practising pharmacist", and advised his colleagues that they would be doing more for the medical services of the country if they devoted more attention to those fields of activity which do not involve legislation, than if they spent time in striving for such politically unattainable goals as the reservation to them of the sale of all medicines. He impressed on them the importance of 'personality'; the greatest asset for the individual pharmacist in the future, he said, would be his individuality.

Two papers related to ergot. One of them, by C. H. Hampshire and M. W. Partridge, was from the laboratory of the British Pharmacopœia Commission, and the second, by N. L. Allport and N. R. Jones, from the laboratories of the British Drug Houses, Ltd. The first consisted of notes on the extraction and decomposition of the alkaloids; it showed that neither continuous extraction of ergot with methylene dichloride nor shaking ergot with menstruum of ammoniacal acetone completely extracts the alkaloids, which are completely extracted, however, by continuous extraction with anæsthetic ether. In the second paper, the authors described a rapid method for the determination of ergometrine and ergotoxine.

A paper, by H. Berry, from the College of the Pharmaceutical Society, on the components of acriflavine, was summarized by the author as follows: (1) the bacteriostatic value of the two active components and mixtures of these in varying proportions have been compared against certain organisms; the results show little variation; (2) there is no evidence of a bacteriostatic or physical character of any definite combination between the two components; (3) it is suggested that proflavine or the neutral hydrochloride of 2 : 8-diaminoacridine should replace acriflavine for surgical use.

A second paper, by F. Wokes, from the College of the Pharmaceutical Society, had as its subject "The Subcutaneous Implantation of Thyroxine Tablets". The author suggested that great caution be employed in the implantation of thyroxine tablets in human subjects, and that preference be given to the oral administration of thyroid, which appears to be much safer and more effective.

A paper, by A. M. Briggs and D. E. Callow, from the Evans Biological Institute, dealt with the preparation of sterile solutions of procaine hydrochloride. The author's conclusions are that sterile solutions can be prepared without the use of bacteria-proof filters, provided aseptic methods are used. Solutions prepared with an antiseptic present are not vulnerable to contamination likely to occur in a laboratory devoted to the production of sterile preparations. Solutions prepared with both an antiseptic present and an oxidation-preventive substance such as sulphur dioxide are even less vulnerable to contamination. The antiseptic properties of solutions of procaine hydrochloride tend to increase with increase of percentage strength.

A second paper, by G. E. Shaw and H. G. Hind, from the Evans Biological Institute, was on "Some Aspects of the Storage of Antitoxins During War-time". Antitoxic serum, the blood serum of hyper-immunized animals, is issued for sale either in its natural state or, more usually, as a solution of a selected protein fraction therefrom; it is of special importance in war-time owing to the exposure of the population to risk from epidemic disease and the occurrence of a large number of injuries which necessitate antitetanic treatment. Antitoxin is stored in a sterile condition at about 4° C. in large glass containers. In view of the risk from damage through enemy aerial activity, bulk storage presents a serious problem, owing to the possibility of containers breaking and the supply of electricity to the refrigerator plant being interrupted. The authors sought for a method which would eliminate the need for glass containers, and make the use of refrigeration unnecessary, but would, at the same time, preserve the potency and maintain the sterility of the product. They described two methods, each yielding a dry powder which may be stored in any type of container. The potency of the product is maintained. Cold-storage accommodation is unnecessary, and the powder is self-sterile. The desiccation method requires special apparatus for drying, but this does not involve a large capital outlay. The material contains so much preservative that, although reasonable care in handling is naturally adopted, complete asepsis is not essential.

PHOTOPHORES IN DECAPOD CRUSTACEA

DR. R. DENNELL'S work on the structure of the photophores in certain decapod crustacea from deep water is of outstanding interest and importance*. It has been known for long that luminous organs exist in many of the deep-sea decapods; but it is astonishing to find such a variety of structure and so much difference in closely related forms.

The photophores described in this work are not all proved luminous organs, but morphological evidence makes it extremely likely that this is so. Only in a few cases have live animals been seen to emit light, but those who have observed the phenomenon have made careful notes of the position of the light organs, and in these cases it is certain that true photophores are present. The reason for the luminescence is still obscure. As in the squids and fish which possess them, the luminous organs mostly throw their light downwards, lighting an area outside the field of vision, it is especially difficult to understand why in nearly all species of Sergestids examined, and also in Parapandalus, some of the photophores should be situated in such a position that they must illumine the branchial chamber and throw light downwards on the gills. There is nothing in the structure of the gills themselves to show that they could benefit from such illumination, and it may be as is suggested (but with serious objections) that the development of light-organs here is simply the response to a rich oxygen supply.

Within the genus Sergestes no fewer than four different types of photophores are found: (1) The organs of Pesta which occur in the larger number of species and are modified liver tubules of endodermal origin; (2) complex organs with lenses scattered superficially on the body which are found in *Sergestes challengeri* and its allies; (3) superficial simple organs without lenses scattered over the body as in *S. regalis* (this being an entirely new type of luminous organ); (4) simple superficial streaks on the carapace which are found to be present in those species which also possess the organs of Pesta. The second and fourth of these are of ectodermal origin, the third may be ectodermal, or, possibly, mesodermal. It is shown that the structure of the photophores in the various species of Sergestes may be entirely different and that it is unsafe to conclude that any are similar unless the minute structure is examined, even if they are in the same position.

In *Parapandalus richardi*, which with some other pandalids possesses photophores outwardly like the main bodies of the organs of Pesta of Sergestids, these organs have a totally different minute structure. It is a remarkable fact that such similar organs should have been separately evolved in the two groups; it shows that they must subserve some important function, if, as yet, not sufficiently understood. There are also in Parapandalus organs on the pleopods which are doubtfully designated as photophores.

In the Hoplophorids the photophores have reached a very high state of complexity, and here again a variety of types is shown, movement being well developed. The pleopod organs are very similar in all the species of Hoplophorus and Systellaspis examined, but the other types occur very irregularly; photophores in similar positions in two species are frequently entirely different in structure, while in a single species a number of different types of organ is to be found. For the most part the various kinds of organ are entirely distinct and they do not form stages in a developmental series. It is a remarkable fact that the luminous streak behind the fifth leg, which is a conspicuous feature in both Systellaspis and Hoplophorus, should have an entirely different structure in these two closely related genera.

The present investigation is a purely morphological one, but it is impossible to describe these organs of such unusual diversity without touching on their probable function and methods of working. The remarks made are suggestive and cry aloud for more work on this extremely interesting subject.

In conclusion, tribute must be paid to the very excellent technique and quality of the illustrations throughout.

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* On the Structure of the Photophores of some Decapod Crustacea. By Dr. Ralph Dennell. Discovery Reports, 20, 307–382, plates XXIV–XXVI (1940).

FORTHCOMING EVENTS

Saturday, April 26

North of England Institute of Mining and Mechanical Engineers (in the Lecture Theatre of the Institute, Newcastle-upon-Tyne), at 2 p.m.—Mr. R. D. Beilby: "The Prevention of Gas-Ignition in the Overcut".

Monday, April 28

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Dr. G. Stafford Whitby: "Chemotherapy", I.

Tuesday, April 29

Institution of Civil Engineers (at Great George Street, London, S.W.1), at 1.30 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "The Mechanical Behaviour of Solids" (Forty-seventh James Forrest Lecture).

Royal Anthropological Institute (at 21 Bedford Square, London, W.C.1), at 4.15 p.m.—Mr. H. H. Coghlan: "Prehistoric Iron prior to the Dispersion of the Hittite Empire".

Wednesday, April 30

Physical Society (Colour Group) (at the Royal Photographic Society, 16 Prince's Gate, London, S.W.7), at 2.30 p.m.—Mr. H. D. Murray: "Colour Terminology".

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Dr. O. R. Tisdall: "The General Practitioner and Scientific Thought".

Royal Meteorological Society (at 49 Cromwell Road, London, S.W.7), at 4.30 p.m.—Major H. C. Gunton: "Report on the Phenological Observations in the British Isles from December 1939 to November 1940".

Thursday, May 1

Linnean Society of London (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Dr. Agnes Arber: "The Tercentenary of the Birth of Nehemiah Grew".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in Engineering Subjects—The Principal, County Technical College, Worksop, Notts. (April 30).

Lecturer in Physics and Mathematics at the Harris Institute—The Principal, Technical College, Corporation Street, Preston (May 2).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

ASLIB War-Time Guides to British Sources of Specialised Information. No. 2: Agriculture and Allied Interests. Pp. 40. (London: Association of Special Libraries and Information Bureaux.) 5*s.* to Members; 6*s.* to non-Members. [193

Imperial Bureau of Horticulture and Plantation Crops. Occasional Paper No. 6: Haricot Beans. Compiled by G. St. Clair Feilden. Pp. 20. (East Malling: The Research Station.) 1*s.* [213

Brompton Hospital Reports: a Collection of Papers recently published from the Hospital. Vol. 9, 1940. Pp. v+175+24 plates. (London: Brompton Hospital.) 5*s.* [263

British Electrical and Allied Industries Research Association. Technical Report, Reference M/T67: Radio Interference from Thermostats in Refrigerators and Irons. By S. F. Pearce and Dr. S. Whitehead. Pp. 11+12 plates. 4*s.* Technical Report, Reference M/T69: The High Frequency Properties of various Forms of Wire Specimens. By G. G. Sutton. Pp. 19+13 plates. 6*s.* (London: British Electrical and Allied Industries Research Association.) [263

Medical Research Council: Brain Injuries Committee. M.R.C. War Memorandum No. 4: A Glossary of Psychological Terms commonly used in Cases of Head Injury. Pp. 4. (London: H.M. Stationery Office.) 1*d.* net. [263

The Institute of Fuel. Its Origin and Purpose, List of Council and Members as at February 1941. Pp. 106. (London: Institute of Fuel.) [263

Proceedings of the Royal Society of Edinburgh. Section B (Biology), Vol. 61, Part 1, No. 2: Non-Associative Algebra and the Symbolism of Genetics. By Dr. I. M. H. Hetherington. Pp. 24–42. (Edinburgh and London: Oliver and Boyd.) 1*s.* 6*d.* [263

Air Ministry: Aeronautical Research Committee. Reports and Memoranda No. 1888 (4207): Methods for Calculating the Frequencies of Overtones. By Prof. W. J. Duncan and D. D. Lindsay. Pp. 20. (London: H.M. Stationery Office.) 3*s.* net. [273

British Rubber Producers' Research Association. Publication No. 1: Elastic Recovery and Plastic Flow in Raw Rubber. By L. R. G. Treloar. Pp. 13. Publication No. 2: The Proteins of *Hevea brasiliensis*. By G. R. Tristram. Pp. 6. Publication No. 3: Fractionation of Rubber. By George F. Bloomfield and Ernest Harold Farmer. Pp. 18. Publication No. 4: The Molecular Weights of Rubber and Related Materials, 1: Experimental Methods. By G. Gee. Pp. 11. Publication No. 5: The Molecular Weights of Rubber and Related Materials, 2: Osmotic Pressure and Viscosity of Solutions of Raw Rubber. By G. Gee. Pp. 8. Publication No. 6: Relation between Molecular Weights and Physical Properties of Rubber Fractions. By G. Gee and L. R. G. Treloar. Pp. 14. Publication No. 7: Crystallisation Phenomena in Raw Rubber. By L. R. G. Treloar. Pp. 15. (London: British Rubber Producers' Research Association.) [283

Other Countries

Government of India: Department of Labour. Irrigation in India Review for 1937–38. Pp. iii+35. (Delhi: Manager of Publications.) 1·8 rupees; 2*s.* 3*d.* [193

Queensland Forest Service. Bulletin No. 13: Fused Needle Disease and its relation to the Nutrition of *Pinus*. By H. E. Young. Pp. iv+108. (Brisbane: Government Printer.) [193

State of California: Department of Natural Resources, Division of Fish and Game: Bureau of Marine Fisheries. Fish Bulletin No. 57: The Commercial Fish Catch of California for the Years 1936–1939. By the Staff of the Bureau of Marine Fisheries. Pp. 100. (Terminal Island, Calif.: California State Fisheries Laboratory.) [193

Canada: Department of Mines and Resources: Mines and Geology Branch, Geological Survey. Paper 40–17: Preliminary Map, George Creek, Alberta. By B. R. MacKay. 10 cents. Paper 40–22: Preliminary Report—Natural Gas in Brantford Area, Ontario. By J. F. Caley. Pp. ii+31+1 map. Memoir 216: Geology of Saint John Region, New Brunswick. By F. J. Alcock. (No. 2447.) Pp. 65 (4 plates). 25 cents. Memoir 221: Geology of the Southern Alberta Plains. By L. S. Russell and R. W. Landes. (No. 2453.) Pp. iv+223 (8 plates). 50 cents. (Ottawa: King's Printer.) [213

Smithsonian Miscellaneous Collections. Vol. 100: Essays in Historical Anthropology of North America. Published in honor of John R. Swanton. (Publication 3588.) Pp. v+600+16 plates. (Washington, D.C.: Smithsonian Institution.) [213

Proceedings of the American Philosophical Society. Vol. 82, No. 5: Centenary Celebration—The Wilkes Exploring Expedition of the United States Navy, 1838–1842, and Symposium on American Polar Exploration, February 23–24, 1940. Pp. 517–950. (Philadelphia: American Philosophical Society.) 2.50 dollars. [213

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 103: An Examination of some Australian Hardwood Charcoals, with Special Reference to their Suitability for Charcoal Gas Producers. By J. N. Almond, B. M. Holmes and Enid C. Plante. Pp. 28. (Melbourne: Government Printer.) [213

Australasian Antarctic Expedition, 1911–14. Scientific Reports, Series B, Vol. 2: Terrestrial Magnetism and related Observations, Part 3: Magnetic Disturbance at Cape Denison. By Dr. J. M. Stagg. Pp. 333–450+plates 7–14. 15*s.* Part 4: The Transmission of Wireless Signals in relation to Magnetic and Auroral Disturbances. By Charles Seymour Wright. Pp. 451–534. 9*s.* 6*d.* (Sydney: Government Printer.) [213

Carnegie Institution of Washington. Year Book No. 39, July 1., 1939–June 30, 1940, with Administrative Reports through December 13, 1940. Pp. xxxi + 326. (Washington, D.C.: Carnegie Institution.) [263

Svenska Linné-Sallskapets Årsskrift. Årgång 23, 1940. Pp. v+123. (Uppsala: Svenska Linné-Sallskapet.) [263

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ended June 30, 1940. Pp. iii+118. (Washington, D.C.: Government Printing Office.) 15 cents. [283

Catalogues

The Hilger Non-Recording X-Ray Microphotometer, (S.B. 294.) Pp. 4. The Spekker Photo-Electric Fluorimeter. (S.B. 295.) Pp. 4. (London: Adam Hilger, Ltd.)

The Babcock Fuel Sampler. (GT.1306.) Pp. 2. The Microid Automatic Pipette (B.D.H. Pattern). (GT.1311.) Pp. 2. Reagent Bottle Drip Eliminators. (GT.1313.) Pp. 2. The Metrovick Artificial Daylight Laboratory Lamp. (GT.1314.) Pp. 2. The Griffin Four-Six Clamp. (GT.1315.) Pp. 6. "Phoenix Sixty" Filter Funnels. (GT.1317.) Pp. 2. The Microid Laboratory Tube Furnaces. (GT.1318.) Pp. 6. New High Vacuum Gauges. (GT.1320.) Pp. 2. The Microid Gas Generator. (GT.1321.) Pp. 6. Price List—Catalogue 15B: Chemical Apparatus. (GT.1323.) Pp. 16. The Vacustat. Pp. 2. (London: Griffin and Tatlock, Ltd.)

The Electrophoresis Apparatus with Improved Optical System. (SB.293.) Pp. 12. (London: Adam Hilger, Ltd.)

Important Books. (Catalogue 654.) Pp. 70. (London: Francis Edwards, Ltd.)

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ANGLO-AMERICAN COLLABORATION FOR DEMOCRACY

DURING last summer, in the early stages of the Battle of Britain, the Prime Minister was reviewing the first year of the War and spoke in homely terms of the English-speaking democracies, the British Empire and the United States, having "to be somewhat mixed up together in some of their affairs for mutual and general advantage" ; some time earlier, a manifesto issued on behalf of American men of science, like an earlier resolution of the American Association for the Advancement of Science, had frankly recognized the relation of science to freedom of thought and speech under democratic institutions, and the need for men of science to draw closer together in defence of democracy. The offer of naval bases to the United States, which prompted Mr. Churchill's reference, was only a stage in the development of the association of interests for common purposes between Great Britain and the United States which had already commenced before the War, and which has recently been further recognized by the request from the American Association for the Advancement of Science to the British Association for collaboration in the formulation of an international charter of democracy (see NATURE, April 12, p. 448).

The process which the Prime Minister so warmly welcomed last summer has gathered impetus. In accepting the nomination of the Democratic Convention for election to a third term of office as President of the United States of America, Mr. Roosevelt affirmed the determination of his countrymen to maintain unswervingly in foreign policy sympathy and moral and material support for all free peoples. In subsequent speeches down to the historic speech to the White House Correspondents' Association on March 15, following the passage of the Lease-and-Lend Act, the President has repeatedly indicated how clearly the United States appreciates the great issues which are at stake in the present struggle, and the growing determination of that great democracy to afford not merely sympathy but also the maximum possible support in arms, ships and food which are required by those who now hold the bridgehead of freedom and humanity's hopes.

Nor have Mr. Churchill and President Roosevelt been alone in making it clear, in speeches that have brought the two great democracies closer to each other than ever before in their history, that the two peoples are threatened by the same danger. It was a happy choice that brought a former director of the International Labour Office across the Atlantic to represent the United States in Great Britain, and Mr. Winant's address at the Pilgrims' luncheon has already shown how well qualified he is to interpret the common ideals and basis of our civilization, and to promote that co-operation which in this interdependent world is the only alternative to domination or disaster—the co-operation of free peoples to overcome the fear of domination which has brought so much grief to this generation. It is indeed permissible to see in Mr. Winant's appointment the symbol of American acceptance of a common duty to the world.

Viscount Halifax, in his turn, has given equally happy expression to the Anglo-American unity of purpose which has been sealed by the passage into law of the Lease-and-Lend Act. This noble interpretation of the principles which are essential to life as we wish to live it and to see it lived, has been as welcome and inspiring on this side of the Atlantic as to those entering on the new and strenuous programme of aid for Britain to whom his words were primarily addressed. Lord Halifax demonstrated the complete agreement of the British Government with the purposes President Roosevelt described with such vivid force in his speech a few days earlier.

There is every reason to believe that, in the pursuit of this common purpose, the two democracies may find a tie that will make them effective reformers and champions of liberty. Nor is this all. Lord Halifax, like Mr. Winant, looks forward to the post-war world : "This business of rebuilding after the War will be a task far beyond the strength of any single country." New needs will demand new remedies, and there will be room alike for all the courage and imagination of youth and all the clear thinking of experience that can be rallied to the task. No tyranny will frustrate the Anglo-American co-operation that is seeking to win a free world, but even more significant for humanity may be the awakening of the two peoples to the immense responsibility that will rest upon them. In the words of Pascal, to "combine justice and power, making what is just strong, and what is strong, just", may deserve and win the support of all other peoples likeminded with ourselves to strengthen the foundations of world society.

The future structure of the community of nations cannot yet be clearly seen. Much indeed may be learnt from a careful study of the past, and it is already clear, from the discussions of the last two years on different proposals for a federal world, that whatever form of co-operation is to succeed must be based on a real community of interests, and on ideals which are widely shared ; further, it must command an allegiance which is prepared to make real sacrifices, both individual and corporate, in their defence and service.

It is this that gives particular significance to the three recently published slight volumes*. Dr. Butler's three essays on "True and False Democracy", delivered more than a generation ago, are as full of meaning for Great Britain to-day as when they were delivered in California, in Michigan and in Buffalo. Together they indicate the dangers which democracy has to face in either country, and the great community of democratic institutions which is the heritage of both. We have indeed reason to be grateful that the two nations have leaders and representatives on both sides of the Atlantic who are able to undertake so ably and inspiringly the vital task of education on which Dr. Butler lays his main stress. Prof. J. B. Conant's recent visit to Great Britain has disclosed the extent to which American men of science, as has long been known to their scientific colleagues, are actively with us in our war effort.

Dr. Butler's able analysis of the weakness and strength of democracy leads indeed to the conclusion that, had due attention been paid to such warnings, we should never have had to face the present stern challenge to liberty. It is not the United States alone that has need of an aristocracy of intellect and service. The paucity of genuine thinking and neglect of, or indifference to, electoral and social responsibilities among the citizens of the democracies are among the main reasons for the straits in which we are now placed. Dr. Butler's analysis is more searching than Lord Davies's somewhat bitter indictment of leadership in Great Britain, for an electorate accustomed to think for itself, to face facts and accept responsibilities, would not have been slow to rid itself of incompetent or hesitant leaders. It is the moral basis of democracy that is all-important, and necessitates such untiring attention to the education not merely of public opinion but also of the individual citizen. Without that basis, democracy is indeed effete in the face of the totalitarian regime. From it, as Mrs. Roosevelt shows so clearly in her admirable little book, must come the driving force which will call forth the effort required to establish beyond the threat of force a permanent democracy with its background of spiritual belief.

The great merit of Mrs. Roosevelt's incisive contribution is that it sets forth with admirable lucidity the fundamental issues that are involved in real democracy—the difficulty of achieving a balance between planning and freedom, and the particular challenge to youth, and all that is involved in the acceptance of that challenge and those responsibilities. Democracy, she urges, is a method of government conceived for the development of human beings as a whole, and this dynamic conception involves more than fulfilling our duties as citizens, seeing that our nation is truly represented by its Government and that the Government is responsive to the will and desires of the people.

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* True and False Democracy. By Nicholas Murray Butler. Pp. xiv+111. (New York : Charles Scribner's Sons, 1940.) 1.25 dollars.

The Moral Basis of Democracy. By Eleanor Roosevelt. Pp. 62. (London : Hodder and Stoughton, Ltd., 1941.) 6*d*.

Foundations of Victory. By Lord Davies. Pp. 192. (London and Glasgow: Wm. Collins, Sons and Co., Ltd., 1941.) 2*s*. 6*d*. net.

That will and desire must be made the result of adequate education and adequate material security. We must maintain a standard of living which makes it possible for the people really to want justice for all, rather than to harbour a secret hope for privileges because they cannot hope for justice. Moreover, from this dynamic conception and practice of democracy, there flow not only a gradual rise in the standard of living of all the people, but also that constant sense of vigilance and alertness which makes life an adventure and gives a continuous appeal.

Mrs. Roosevelt's moving picture of the spiritual values of democracy should enlist the warm sympathy of all forward-looking minds, on both sides of the Atlantic. In itself, her book is evidence of how firm are the moral and spiritual foundations upon which may be built the practical schemes of Anglo-American co-operation to which the last, and perhaps most important and suggestive, chapters of Lord Davies's book are devoted.

The central theme of Lord Davies's book is that this is a civil war against a revolutionary movement seeking to impose a new order upon Europe, and that accordingly victory depends upon diplomatic as well as upon military strategy. It is not even sufficient to direct our efforts to the maintenance of morale in Great Britain. The defeat of the enemy cannot be separated from his defeat in the moral and spiritual arena. It is for this reason that Lord Davies thinks our diplomatic efforts should be concentrated in proclaiming our war aims, in order to secure their acceptance by world opinion. Foreign policy and war aims are an integral part of the strategic plan.

Lord Davies insists that the decisive factors in this struggle are war aims and air power. "The former is the rock upon which our morale, our determination to win, rests. The latter is the instrument through which victory can be achieved." He believes that our supremacy in the air can only be achieved with the active assistance and co-operation of the United States, and that Anglo-American co-operation will win the War because their basic peace aims—the suppression of war and liberation of oppressed peoples—are identical, and because their mastery of the air and command of the sea give them the power to insist upon this new order.

Lord Davies recognizes that the basis of Anglo-American co-operation lies in their heritage of representative institutions. Great Britain is the cradle of representative government, the United States the nursery of federalism. The foundations of a lasting peace are to be discerned in the common ideals, the mutual understanding, identity of interests and closest collaboration of the English-speaking peoples. Already the British and American peoples are closer together than were France and Great Britain when the British Government offered the people of France a permanent union on the basis of a common citizenship. Anglo-American co-operation on a broad front is growing rapidly with the war effort of the English-speaking peoples, and Lord Davies visualizes some form of political union of the English-speaking peoples which would hold the peace during the interval, possibly of several years, between the cessation of hostilities and the summoning of a peace conference to review the settlement. Acceptance of such responsibilities by the two great democracies would afford opportunity for real reconstruction, during and after the transitional period, the development of an abiding settlement and some sort of European order or federation.

Lord Davies looks to the existence of resurgents in the numerous countries under Nazi domination to promote such developments as well as to assist in the physical overthrow of the Nazis in the later stages of the War. He would see our foreign policy directed to exploit these possibilities as actively as possible, and would enlist in an international force the numerous allied contingents at present in Great Britain. We should use to the full every opportunity of explaining as widely as possible our fundamental war aims and purpose.

Lord Davies has written a timely book. It offers a challenge to the intelligence and character. which, as Dr. Butler remarks, a triumphant democracy must possess. Slight as they are in volume, these three books offer no mean contribution to the task of education which is so imperative for the maintenance of morale, and to the consolidation of victory, and to that constructive and creative thinking upon which reconstruction and the evolution of any new world order must ultimately be based. Their appearance at this point is indeed a happy augury that the American and British peoples, acting under the inspiring leadership they now possess, will write a new and more splendid chapter in their own history and in that of the world.

AGRICULTURE IN PRACTICE

Soil and Sense
By Michael Graham. Pp. 274. (London: Faber and Faber, Ltd., 1941.) 7*s.* 6*d.* net.

THIS is a most fascinating and instructive book. Its author lays no claim to be either a farmer or a man of science. Yet this illuminating little treatise on several outstanding aspects of modern husbandry contains much stimulating food for thought for those engaged in, or inclined to embark upon, agricultural pursuits; and if 'organized common sense' is still a permissible definition of science, it may not unjustly be included among the manuals of science, as applied to our most vital industry.

It is indeed worthy of a wider clientele, especially at a time when the exigencies of war are establishing, through the process of evacuation, unprecedented contacts between our urban and rural populations. It is calculated, in its breezy conversational style and with its homely metaphors, epigrams and maxims, to stimulate the imagination, and evoke the interest, of the veriest Cockney in the attractions and multifarious activities of Britain's countryside. It exhales the pure atmosphere of a fuller life (especially to those of keen observation like the author himself), than material wealth or an urban environment can possibly bestow. For colourful word painting few modern works of practical utility can bear comparison with its earlier chapters. At the same time its useful lessons are expressed in delightfully popular phraseology far removed from the technical jargon which makes so many English agricultural textbooks inexpressibly dull to the layman. It is fertile in appropriate similes provided out of a storehouse of cultured and versatile knowledge. Seldom indeed has a more attractive medium for absorbing the rudiments of an agricultural education, without intellectual effort, seen the light.

Prefacing his first chapter with excerpts from a typical old farm agreement, the author convincingly and mercilessly exposes, by sound scientific reasoning, and without any display of partisan bias or personal prejudice, the dangerous and myopic fallacy of scrapping—under the political watchword "Freedom of Cropping"—the checks upon soil exhaustion imposed by the restrictive covenants in these old documents, and then ploughing in old turf to restore temporarily the productivity of the starved land. Not that he objects to ploughing in turf. Indeed he welcomes it, so long as it is the half-formed turf of a temporary "ley" (or "lea") such as was initiated some fifty years ago on the Holkham estates of the late Lord Leicester, as a modification of the four- or five-course rotation, developed and expounded twenty years later by Mr. R. H. Elliot under the title of "The Clifton Park System of Farming", and in more recent years effectively popularized, through precept and practice, by Sir George Stapledon, director of the Welsh Plant Breeding Station at Aberystwyth. His theme is, in fact, soil fertility, and the manufacture (by organic and other agencies) and maintenance of humus as the basic condition of its availability to plant life. He recognizes, as did so forcibly the late Prof. Henry Armstrong, the lack of phosphates in the average British soil, but questions the wisdom and the economy of applying basic slag or other phosphatic fertilizers, to the extent usually advocated, in order to make good the deficiency. Climatic shortcomings and leaching may, he opines, defeat the object in view. He regards, as Elliot did, continuous doses of artificials and of lime (in the absence of adequate humus) as conducive to soil exhaustion.

His remedy, like Elliot's, is the employment, in "ley" making, of herbage plants of varying depth of root, and especially of chicory and other deep-rooted herbs. It is, he avers, "the solvent action of the knotting of roots that liberates minerals from the large reserves of even the poorest soils". This problem of maintaining humus and soil fertility under modern systems of husbandry (especially now that motor traction has robbed us of much of the animal manure formerly available) and the extent to which chemical fertilizers can provide manurial requirements, is a subject upon which experts are not wholly agreed. This being so, what purports to be the "common sense" view (ably propounded by the author) merits respectful consideration. It is without doubt true that, in the absence of humus or vegetable matter, lime may prove an exhausting agent, even on "sour" soils. In regard to other mineral dressings the exhaustion, if any, is likely to be caused by seriously upsetting the balance of the manurial constituents of the soil. This has been demonstrated in some parts of New Zealand—which has the finest and least adulterated pastures in the world—by excessive applications of nitrogenous fertilizers in areas suffering from serious phosphate starvation. Incidentally, the illustration (on p. 122) of Mr. Graham's book showing the "mining" activities, at different depths, of the roots of different plants (thus assisting soil aeration and the passage of water) is particularly instructive.

There is no doubt that, although less fertilizer is employed by the average small farmer in Great Britain than in many other countries, much money is wasted by those who can least afford it under the mistaken impression that the same medicine, provided by the chemist, is applicable to all soil and plant requirements. Much, too, is applied wastefully to ill-drained, or waterlogged, land. On these subjects the author directs the would-be husbandman along the path of wise discrimination. In connexion with ley-farming—a subject very apposite to war-time food production in Britain—Mr. Graham makes the surprising, but illuminating, statement that "grazing by *bullocks* is an essential part of grass-farming, without which ley-farming may not be successful". "There is no evidence", he says, "that this sort of farming can be carried out successfully without good hard grazing of the leys by mixed stock. The men who have done it have always grazed hard and well. . . . There seems every reason to think that ley farming will be a failure unless keeping store cattle is a success", and he goes on to say "the bullock . . . must be made profitable *somehow*. . . . Our food supply depends on how he eats grass and what he leaves behind him." This is a view that deserves greater consideration than most of our "arable dairying" enthusiasts have yet vouchsafed to it. The puzzle will be to make the fatting bullock a continuously profitable proposition.

No small portion of this book is devoted to an instructive dissertation on grassland, its constituent plants (gramineous, leguminous, and herbal) and their respective peculiarities, seasonal appearance, relative values and manurial needs. He describes cocksfoot as "the king for ley farming"—although of less feeding value than rye-grass—because it has a deeper root system. The selective grazing of animals, particularly horses, is interestingly noted. Too little perhaps, in view of its deep roots and high protein content, is said about lucerne, or alfalfa, the most valuable fodder crop in the world. The penultimate chapter entitled "Britain as one farm" deserves special study under existing war conditions. In it he summarizes the contentions of previous chapters, advocating a more comprehensive planning of the nation's agriculture to supply the nation's needs and a more economic system of utilizing available implements and labour over larger areas than existing farm units.

Among the author's captivating dicta and slogans are the following: "A good tenant is worth more than a high rent"; "the least skilled man on a farm needs more wit than the 'labourers' of other industries"; "Subsidize wages and drop all other subsidies"; "The money should go to good farmers who feed the land, as tradition says it should be fed, and none should go to those who merely exploit it"; and finally "We are surrounded by a world of nonsense, built out of pieces of sense, put together wrongly. This nonsense world has too much chemistry, forgetting the living earth." Perhaps he is right. At any rate the dictum justifies the title of the book. BLEDISLOE.

GEOLOGY OF COAL

Geology of Coal
By Otto Stutzer. Translated and revised by Adolph C. Noé. Pp. xiii + 461. (Chicago: University of Chicago Press; London: Cambridge University Press, 1940.) 30*s*. net.

THIS volume is largely a translation of Stutzer's well-known work, "Allgemeine Kohlengeologie", but includes a certain amount of revision of the German text by Stutzer himself and much new material, mainly concerning American coalfields, by the late Dr. A. C. Noé, of the University of Chicago. It is designed to supply geologists, mining engineers and others interested in the coal industry, with a full and authoritative account of the many and varied geological problems connected with coal deposits. These are treated broadly in successive chapters dealing with chemical and physical properties of coal, microscopic examination of coal, origin of coal, processing of coal, origin of coal beds, stratigraphy of coal deposits, petrography of coal beds, and disturbances affecting coal beds. Each chapter has its own list of references.

For the first time Stutzer's work is made available in an English translation, and the present edition will certainly find a place on the bookshelves of all who are interested in the geology, mining and technology of coal deposits. The publication of a book of this nature, in which data and illustrations from world-wide sources are brought together, and to the preparation of which a vast amount of research and labour has been devoted, will be widely welcomed by coal geologists as a comprehensive account of the problems in which they are interested. It is alike informative, stimulating and challenging. The general plan of the work seems admirably designed, and with the help of a detailed table of contents and of adequate indexes to subjects, authors and places, the reader has little difficulty in finding any particular subject or reference he may wish.

It is claimed that in the present edition Stutzer's work has been revised and brought up to date. It would, however, be difficult to justify this claim in its entirety. The chapters dealing with the origin of coal, the origin of coal beds, the stratigraphy of coal deposits and the disturbances affecting coal beds, which together make up approximately half the volume, have no references later than 1935, and only six later than 1930. It is disconcerting to find that the very short chapter (4½ pp.) on the processing of coal is based mainly on a text-book published in Leipzig in 1916. It seems anomalous, again, to find that the only reference to Kidston's researches on the Carboniferous flora is to an early paper of 1885, and British readers will certainly note many other omissions that might well have been included in a work published in 1940. It is a pity, too, that in many cases the information on particular subjects or problems is presented as a series of detached notes rather than as a considered and balanced statement. A compilation of this character cannot be expected to be free from errors, but there are a number for which it is difficult to find a reasonable excuse. The inclusion of a reference to a paper on British Carboniferous stratigraphy in the chapter dealing with the microscopic examination of coal on p. 80, and some very obvious errors on pp. 115, 118 and 366, may be quoted as examples.

These defects, however, can be remedied in any later edition, and certainly the volume now issued is a mine of information on all aspects of coal geology and a notable monument to the patient research and erudition of its authors.

M. MACGREGOR.

CLINICIANS AND BIOCHEMISTS

Biochemistry of Disease
By Prof. Meyer Bodansky and Dr. Oscar Bodansky. Pp. x+684. (New York: The Macmillan Company, 1940). 30s. net.

MOST text-books of clinical biochemistry are written chiefly from the biochemist's point of view, and differ little from text-books of biochemistry proper except that practical details are given of the many laboratory tests that have clinical importance. Their arrangement is also biochemical, and it is unlikely that many readers derive much intellectual enlightenment from studying them, apart from those routine clinical biochemists whose job it is to perform these tests.

The book under review is original in that the text is divided up on a clinical-anatomical basis. The successive chapters deal with diseases of the blood, heart, respiratory tract, kidney and urinary tract, digestive tract, liver and biliary tract, pancreas, adrenals, pituitary, thyroid, parathyroids, bone, muscle and male gonads. There are additional chapters on biochemistry in obstetrics and gynæcology, in disorders of nutrition and metabolism and in neurologic and psychiatric disorders. It is apparent that the emphasis is laid on the clinical rather than on the biochemical aspect of the subject. The book is also original in that the treatment of each chapter is theoretical and factual. There are no details of the chemical methods involved in the performance of the various tests; instead are given the normal results of such tests, the findings in the various pathological conditions and an outline of the theories postulated to explain the abnormal results and the cause of the disease. The clinical procedure adopted in performing the tests is generally described.

Such arrangement and treatment has much to recommend it. It is the type of book which usually meets with the criticism of falling between two stools. If this book does so it falls firmly on its feet, and both clinician and biochemist can read it with profit. Each will know a great deal more about the other's problems when they have finished. Biochemistry is still not as fully used as it might be in the hospital ward, and such a book as this, which stimulates interest instead of imparting a mass of practical detail already available in many previous books, or attempting to teach biochemistry to the uninterested medical reader, should do much to make young clinicians appreciate the necessity of the biochemical tests they have done in the laboratory, and may even persuade them to initiate clinical biochemical researches for themselves.

It should be stressed that the book may be *read* rather than studied, since it is written concisely and lucidly with little of the over-attention to detail that is the bane of many American books. For example, the chapter on the pituitary diseases deals only with gigantism and acromegaly, basophilism, dwarfism, cachexia, adiposogenital dystrophy and diabetes insipidus. To those familiar with the multiple classifications adopted by some clinical endocrinologists in Germany and the

It is grievous to think that a casual lorry should have put an end to a life of such rare distinction and of constant service to his fellow-men ; yet it is well to be able to think that the best was left to the last. Other men might perhaps have done his public work, though not with the same dignity, good judgment and perseverance. But no one can think of a writer and thinker—for many decades back—who could have produced the "History of Europe". It is practically the history of Western civilization and he had dreamt of it and worked at it during the many toils which took him afield. It is full of learning well-arranged and beautiful to read. If Fisher could have included more science and technology it would be a faultless masterpiece. I know people who make a point of reading some of it every day.

F. S. Marvin.

STEPS TO AN ISLAND

The Way to an Island

By R. M. Lockley. (Travellers' Tales.) Pp. xi - 208 + 16 plates. (London : J. M. Dent and Sons, Ltd., 1941.) 7*s*. 6*d*. net.

R. M. LOCKLEY has written a number of books dealing with natural history and life on lonely islands, but he has never written a better book than this. I do not mean that there is a greater wealth of accurate observation in this book : I refer rather to the style. The English is admirable ; it is simple and direct, very vivid and holding the reader's attention from first page to last. It is indeed a book worthy of the most celebrated masters of modern English prose—Masefield would surely read it with pleasure.

Perhaps, although Mr. Lockley has already written so much on his bird-haunted isle of Skokholm, one could wish that more of this book were devoted to his life on that island. But, as the author says, he has described that life in other books and this work deals with his earlier life—his school days, his intense love of Nature, his dream of owning an island somewhere between Lundy and North Rona, his setbacks and the final fulfilment of his dream.

His description of hearing as a boy the wood warbler's song is admirable (p. 65) :

> "'See-ee--ee -ee -ee-ee-ee ! ' cried the wood-warbler in his vibrating voice, and his whole body shivered with delight. A million leaves in the tops of the trees swayed in a rustling chorus which swamped the last sighing notes of the singer. Yes, yes, this is the time we dreamed of in the long wait and coolness of winter, the time of contentment and friendliness and fullest perfection. And with my heart full of a rare joy I waited for the three bell-like notes which concluded the wood warbler's song. They seemed to round off that astonishing magic madrigal by giving utterance to the sadness of replete happiness."

Of his first spring on Skokholm—he had passed the winter in hard work repairing the one house on the island—and his difficulties with the garden the author gives an arresting description. Of the garden he writes (p. 184) :

> "The garden gave me pleasure and anxious moments by turns. Something like a ton of bracken and nettle and blackberry roots had been removed and burnt, and by degrees I had planted the rich loam with currant and gooseberry cuttings, broad beans, peas, shallots, early potatoes, parsnips, and so on. But rabbits had found a way in more than once, and I had lost some cabbages I had put down. Then with the first mild weather thousands of snails crept from the cracks between the stones in the herring-bone patterned hedge wall. The snails found my tender young stuff excellent after the years of grazing on tough bracken, nettle, and weed. I collected them by the bucketful every evening, and threw them into the sea. I had no help from the birds. All the thrushes had left the island with the coming of spring, and the single blackbird and his mate took no interest in snails."

But success crowned his efforts (p. 188) :

> "How the plants grew ! The marrow-stem kale shot up and opened leaves like miniature banana palms. The corn grew shoulder high. The potatoes were huge. The lines of blue chicory and yellow dandelion gave this field-garden a gay look. The wild rabbits came out every afternoon and inspected the garden from without the wire-netting fence."

From Skokholm the author and his wife sailed out to, and lived for a day or two upon, the still more lonely and remote ocean isle of Grassholm, accessible only in very fine weather when the ocean swell is at rest. Here they watched the gannets at their nesting colony, observed the habits of the grey seals, and slept on the long grass on the east (and comparatively sheltered) side of the island where they could see, across the gannet-haunted miles of ocean, their own island of Skokholm rise on the eastern horizon.

Truly, this is a book to take the thoughts off these grim days of strife, and transport the spirit to admirable and lovely things in the serene world of Nature.

Seton Gordon.

United States such a rigid confinement to essentials is very welcome.

The references are well chosen; in general the original paper on any subject is referred to, but only papers of the last ten years are quoted afterwards. All the graphs and tables are taken from original papers. Indications for theoretical reading are apt and full; references to the main review articles by Himsworth, Long, Houssay and Soskin should enable any reader quickly to become conversant with the modern views on diabetes mellitus. The references are also surprisingly up to date. Though most of the work on the chemistry and antihæmorrhagic activity of vitamin K was only done in 1939, the subject is well covered in the book, which is dated March 1940. Such topicality leads one to hope that further editions will be called for at short intervals. Physically the book is well produced, with detailed author and subject indexes, good printing and real binding. The casing adopted by most English publishers is generally quite inadequate to withstand the wear that such books as this may be expected to undergo through constant reference over a period of years.

English readers of American books often seem to find some jarring spelling or syntax offending their pedantic ears. This book compares the size of the pituitary to that of the navy bean. Some future international conference on nomenclature might amuse itself by devising series of internationally recognized nuts, beans, etc., graded according to size for the purposes of such comparisons.

MR. FISHER'S AUTOBIOGRAPHY

An Unfinished Autobiography

By H. A. L. Fisher. Pp. xi + 163 + 4 plates. (London, New York and Toronto: Oxford University Press, 1941). 7*s.* 6*d.* net.

IT was a grievous loss to Oxford and to Great Britain when Mr. Fisher was killed in an accident in London at the beginning of last year. He had written as far as his visit to Canada and New England, and had recovered from the serious breakdown which followed his great work on the history of Europe, which had appeared in a cheap form in 1936 and is a prized book by all who value perfect style and profound knowledge. He had begun to work again with his accustomed vigour and devotion when the accident happened, and we have to add his name to that of the many whom we have lost at this critical time in our history. He would have been a wise counsellor at the many grave moments which have fallen upon us since he passed away. Mrs. Fisher gives in her foreword a touching account of the stream of inquirers and letters which poured into New College in his last years. It was a marvellous life. One can scarcely think of anyone who combined so many activities and performed them all with wisdom and success.

Fisher was born in 1865, and his father, who had studied for the law, was selected by the Prince Consort to be private secretary to his eldest son and spent five years in Court life, always retaining the goodwill and affection of the royal family. On his mother's side he was a Pattle and had through that family both his distinguished appearance and his intimate knowledge of India, with which the Pattles were connected by several branches and various official posts. He thus started high in the social scale, and he widened his knowledge and circle of acquaintanceship by a long stay in Paris after he had finished his course at Winchester and New College. He made two lecturing trips to South Africa and the United States and served on the Indian Public Services Commission (visiting India twice) before he was offered the vice-chancellorship of Sheffield between the years 1913 and 1916. A great deal of public work was interspersed with all this, and it ended in his being asked to join Mr. Lloyd George's Government in December, 1916.

This episode in a marvellous career had almost as many varied experiences as the years which had preceded it. It is too long to describe in detail. The different posts which he was asked to fill at different times in the six years during which he remained with Mr. Lloyd George were the mark of a man of almost infinite capacity, though specially wedded to his first love of knowledge and of modern history. It was as minister of education that he took office and at the Board of Education that he did his chief official work. Secondary education was transformed by the liberal raising of salaries, and a scheme for the extension of the school age with the provision of compulsory continued education from sixteen to eighteen was passed but has not yet been put into force.

Fisher left Sheffield finally in 1918, and the interval from that to the wardenship of New College was filled up with a multitude of useful and always intellectual occupations until the wardenship fell vacant in 1925. New College was his home, study his recreation and the adornment of Oxford his hobby ever since.

The Photismi de Lumine of Maurolycus

A Chapter in Late Medieval Optics. Translated from the Latin into English by Henry Crew. Pp. xix+134. (New York: The Macmillan Company, 1940.) 15*s.* net.

"LIGHT concerning Light", the playful title given by Franciscus Maurolycus (1494–1575) to his short text on optics, suggests a certain sense of humour in the author, a prominent churchman and man of science of his day, which might have saved him from the inconsistency of outlook so painfully apparent from the modern point of view in this book. Mr. Henry Crew's charming translation brings within the reach of all a work which is in itself an eloquent comment on the folly of certain chapters in human thinking, especially the kind of thinking which strays over-far from experience and experiment.

As Mr. Crew remarks in his introduction, Euclid furnished the norm for a scientific demonstration throughout the sixteenth century. The assumptions, the data, the theorem and the logical steps to its establishment had to be set out in order. All is well in the early stages, when the law of reflection starts discussion of problems in geometrical optics, and it is even possible to get some distance in theorems regarding refraction, although only the qualitative and not the quantitative law of refraction is known. But when a writer seeks to cast his speculations on the origin of colours, the phenomena of the rainbow, the action of the human eye and the like into the same form, he lays a trap for the ignorant and unwary, who may fail to distinguish the sudden emptiness of speculation from the proper process of thought.

This book, then, makes a re-appearance largely on account of its human interest, though it is a worthy addition to the historical optical literature already available in English. At a time when half the world appears ready to abandon sanity for catch-words and catch notions, anything which by attention to past follies would help mankind to detect its present ones seems like a draught of water in dry weather. The book would make a very suitable present for certain folk of the present day who write pontifically on vast problems with the aid of a little elementary chemistry and biology.

The publishers are to be congratulated on the attractive binding and excellent printing, which make this little book a pleasure to handle. L. C. M.

Quantitative Analysis

By Prof. Harold Simmons Booth and Prof. Vivian Richard Damerell. (International Chemical Series.) Pp. xi+246. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 15*s.*

IN "Quantitative Analysis" Profs. Booth and Damerell have produced a text-book avowedly for elementary students, but it covers a fairly wide field in its thirty-four chapters. The authors have set out with the intention of impressing upon beginners in analytical chemistry the vital necessity for extreme accuracy. Indeed the clue to the whole tenor of the book is to be found in the introductory chapter where the authors state that "one of the most important requirements for successful experimental work is to be honest with oneself. A high degree of personal integrity is absolutely necessary for lasting success in any science". To ensure that the student will thoroughly digest these truths, the authors have taken the greatest care to give very full details of procedure and explanations of experiments. In fact the wealth of advice, warning and instruction on laboratory technique which normally one learns only by long and often costly experience constitutes a novel feature of this text-book.

The actual experimental work described is confined to the determination of simple elements and radicals and has been selected not with the intention of being exhaustive but with the object of illustrating the basic principles of quantitative analysis. The general theory of gravimetric and volumetric analysis is simply but lucidly explained, and each chapter of the book contains a set of questions whereby the student can subject himself to a "self-examination".

This book can confidently be recommended to beginners in chemistry, and if the student assimilates both the chemical knowledge and the wealth of practical detail contained in the volume, he can scarcely fail to emerge as a most careful and highly qualified analyst.

Select Bibliography of South African Native Life and Problems

Compiled for the Inter-University Committee for African Studies, under the direction of I. Schapera. Pp. xii+250. (London: Oxford University Press, 1941.) 10*s.* 6*d.* net.

A "SELECT" biography tends to arouse a certain diffidence, not to say mistrust, in the manner of its reception; but when the material is drawn from a space of four centuries and a literature of the proportions and character of that relating to the natives of South Africa, much weeding is necessary if a practical value is to be secured for anyone who is not already in a great measure expert. The danger of bias, which may be, and indeed often is quite unconscious, has been eliminated in this South African bibliography by calling in the assistance of experts each to be responsible for the department of native studies in which he is an accepted authority, such as, for example, Prof. M. R. Drennan (physical anthropology), or Dr. A. J. Goodwin and Prof. C. van Riet Lowe (archæology) or the Rev. C. M. Doke (linguistics). The editor, whose ability to take an objective and scientific view of native problems has been abundantly demonstrated on many previous occasions, has been responsible not only for the section covering ethnography, both general and tribal, but also for that which deals with the status of the modern native population. It is perhaps unnecessary to comment on the fact that this last-named is the most considerable section in the bibliography, covering 93 pages as against ethnography, 72 pages. The very brief notes following entries, and indicating the scope and character of the item catalogued, will be found helpful and trustworthy by young students.

THE PHYSICAL CONDITION OF THE PLANETS*

BY SIR JAMES JEANS, O.M., F.R.S.

AS the power of telescopes increases the astronomical horizon for ever recedes, drawing many astronomical workers with it, but leaving a few to continue their labours in the older fields. I propose here to discuss some recent work in the oldest field of all—the planets.

The physical condition of a planet depends on many factors, the most important being its distance from the sun. For we have learned in recent years that each planet gives out just about as much light and heat as it receives from the sun, and no more. Thus the planets have but little heat of their own, and are hot only to the extent that they are warmed by the sun.

Yet distance from the sun is not everything. The earth and the moon are at the same distance from the sun, so that their average temperatures are approximately the same, but their physical conditions are widely different. The moon is a dead world in which we see mountains of volcanic rock rising from plains of lava and ash, while the earth teems with life. While the earth's temperature remains fairly steady through the alternations of day and night, that of the moon rushes from one extreme to the other. According to Pettit (1940) the moon's temperature can fall from 101° C. to − 117° C. during an eclipse. The change of temperature is far more violent than anything we experience on earth because the moon cannot, like the earth, draw on heat stored in its soil or atmosphere. It has a surface which is probably composed of lava and ash, which are almost perfect non-conductors of heat, and it has no appreciable atmosphere—an inevitable consequence of the smallness of its mass. The earth is strong enough gravitationally to retain the molecules of its atmosphere, while the moon is not.

Bodies of intermediate mass may retain the heavier kinds of molecules, while the lighter escape. For each planet we can calculate which gases are debarred, by their lightness, from appearing in the planet's atmosphere, although to know which actually do appear we must have recourse to observation.

The light by which we see a planet is simply sunlight which has passed twice through the planet's atmosphere—once in going in and once in coming out. These journeys may produce absorption bands in the spectrum of the light, and from these we can deduce the composition of the atmosphere, at least in part. There may also be some loss of light resulting from reflection at the planet's surface, for no substance reflects light perfectly. The proportion of light lost is different for different colours and by comparing the reflecting powers of the surface, colour by colour, with those of known terrestrial substances, it may be possible to identify the material of which the surface consists. Lyot has recently found that both the reflecting powers and the polarizing powers of the surfaces of Mercury, Mars and the moon are all identical with those of lava and pumice. Thus we can scarcely doubt that the surfaces of all these three bodies consist of the products of volcanic eruption in some form or other.

Let us now consider the various planets in turn, commencing with those nearest to the sun.

MERCURY

Nearest to the sun and so hottest of all the planets is Mercury. Just as the moon always presents the same face to the earth, so Mercury always presents the same face to the sun. Thus on one hemisphere of Mercury there is perpetual day—and a very hot day—while on the other hemisphere it is always night—and probably a very cold night. At the point directly under the sun, where it is always noon, the temperature is found to be about 650° F., a temperature at which lead and tin are both liquid.

It is still debatable whether Mercury possesses any considerable atmosphere or not. It is the least massive of all the planets, with only one twenty-second of the substance of the earth, and its power of retaining an atmosphere is small. Under present conditions it would retain oxygen and all heavier gases, but in the past, when it was presumably hotter even than now, all gases except the very heaviest may well have streamed off into space. On the whole its surface markings are so permanent and clear-cut as to suggest that no atmosphere in fact exists. Yet Schiaparelli noticed fifty years ago that some of the surface features were occasionally seen blurred, or even obscured, as though by some sort of cloud, and Antoniadi has recently (1929) confirmed and extended his observations. As the planet could not retain molecules of water vapour, and so must be completely arid, it has been suggested that the clouds may consist of particles of dust, possibly set free by falls of rock. Even so there must be some sort of atmosphere to save the dust particles from immediately falling back on to the surface of the planet.

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* From a discourse delivered at the Royal Institution on March 25, 1941.

Venus

After Mercury comes Venus, the slightly smaller twin sister of the earth. The small differences of size and mass do not produce any appreciable difference in the atmosphere-retaining capacities of the two planets, and Venus, like the earth, can retain all gases, including hydrogen. Thus if we approach the problem merely in terms of the present state of the planets, we might reasonably expect Venus to exhibit an atmosphere similar to that of the earth, although perhaps somewhat smaller in amount.

Actually the two atmospheres are found to be very different. Something of this difference is suggested by the general appearance of Venus, which presents only a continuous cloud-like surface to our view. Gerasimovič has made a study of the brightness of this cloudy envelope and of the way in which it changes with the phases of the planet, and has shown (1937) that it cannot be gaseous but must consist of large scattering particles—probably products of condensation, like the ice crystals which form the cirrus clouds in our own atmosphere. We have no means of exploring whatever atmosphere there may be below this stratum of clouds, but the "upper atmosphere" above it can of course be examined spectroscopically.

Hydrogen, nitrogen and the inert monatomic gases cannot in any case be detected spectroscopically, but oxygen and most compounds can when present in reasonable amounts. A study of the upper atmosphere of Venus reveals no oxygen and no water vapour, but an abundance of carbon dioxide. This does not necessarily mean that there is no oxygen or water vapour at all, but it means there is very little. If all the oxygen in the earth's atmosphere were collected and spread out in a layer at atmospheric pressure, this layer would be considerably over a mile in thickness, while the carbon dioxide would form a similar layer only a very few feet thick; for the upper atmosphere of Venus, the corresponding thicknesses would be less than six feet of oxygen and more than two miles of carbon dioxide. In brief, carbon dioxide and oxygen change places. Further, St. John found that the total amount of water vapour in the upper atmosphere of Venus is certainly less than that above the highest clouds on earth.

Why should there be so great a difference in the atmospheres surrounding two such similar masses? And why in particular should the oxygen in the earth's atmosphere be free, while that in the atmosphere of Venus is combined with carbon?

As oxygen combines so eagerly with other substances, we might reasonably have expected to find but little free oxygen left in either atmosphere. It has often been suggested that the free oxygen in the earth's atmosphere may be a direct result of the vegetation on the earth's surface; that as this breaks up compounds of oxygen, carbon dioxide in particular, it sets oxygen free in the air. But this can scarcely be the whole story, since primitive life must have required, and found, some free oxygen when it first arrived on earth. Tamman has suggested (1924) that, while the earth was still hot and its solid crust not yet formed, a considerable amount of free oxygen would be produced by the thermal dissociation of water vapour. He calculated that if the whole of the water, ice and snow at present on earth were restored to the temperatures of this epoch, there would be enough water molecules dissociated to provide all the free oxygen at present residing in the earth's atmosphere. The free hydrogen would not, as at present, be retained but would stream off into space. No doubt some of the free oxygen would in due course combine with the solidifying rock of the earth's crust, but vegetation would afterwards come into being to restore the balance. So long as we can postulate both water vapour and vegetation, there will be no great difficulty in accounting for the presence of free oxygen.

If so, there may be no free oxygen on Venus either because there is not enough vegetation, or because there has not been enough water vapour.

As regards the first alternative, we may imagine life to have come to earth as the result of some unusual accident, some rare coincidence, or some special creation, if we prefer. If the corresponding event did not occur on Venus, the whole situation is explained; there is no oxygen, because there is no vegetation. Or it may be that Venus has never cooled down sufficiently for life to appear. There is enough carbon dioxide in the earth's atmosphere to exert a powerful blanketing effect, checking the outward flow of radiation and so keeping the earth considerably warmer than it would otherwise be. The thousand-fold thicker layer on Venus must form a far more potent blanket, and estimates of the temperature of the lower atmosphere of Venus range from about 80° C. to 130° C. Atmospheric pressure on Venus may well be somewhat less than on earth, so that any water that there may be there is likely to exist in the form of steam. If so, Venus must be highly unsuited to life now and must have been even more so in the remote past.

The other possibility, which has been urged by Wildt (1940), is that Venus has always been deficient in water. As Venus and the earth were almost certainly formed out of the same store of matter—the outer layers of the sun—they would probably start with equal amounts of water vapour. But at a later stage, the smaller mass and higher temperature of Venus may have permitted molecules of water vapour to escape from the atmosphere of Venus, while they were still retained by the earth. If so, any small amount of oxygen set free by thermal dissociation might well be seized by the solidifying rocks, and vegetation could not then come, since there would be insufficient oxygen for it to breathe.

There would also be insufficient oxygen or ozone to screen the atmosphere from the ultra-violet rays of the sun. Wildt accordingly imagines photochemical action occurring on an extensive scale, resulting first in the dissociation of carbon dioxide and whatever water vapour there might be, and afterwards in the formation of formaldehyde (CH_2O) and free oxygen. The free oxygen would continue to combine with the rocks, but the formaldehyde might be expected to remain in the atmosphere. Wildt has accordingly examined Venus spectroscopically for formaldehyde but found none (1940). He states that dry formaldehyde is stable at temperatures higher than about 80° C.; at lower temperatures it polymerizes into a white solid of high but unknown molecular weight. Trautz and Ufer found that the injection of a small amount of water vapour into perfectly dry formaldehyde gas produced masses of dense white cloud. Wildt suggests that the clouds we see on Venus are similar, and so consist of solid particles of hydrates of formaldehyde polymers. According to Auerbach, depolymerization into simple CH_2O molecules does not occur until the temperature exceeds 200° C., a fact which fully explains the failure of Wildt's spectroscopic search for formaldehyde. Wildt thinks it possible that Venus's atmosphere may be entirely depleted of water vapour and its surface covered with particles like those which form its clouds—a sort of formaldehyde snow.

In whatever way it may have originated, we can form a fairly accurate picture of the present state of Venus—a hot dry surface, devoid of vegetation and probably of all life such as we know on earth, surrounded by an atmosphere in which there floats a continuous layer of opaque clouds, which are probably similar in their physical, although not in their chemical, constitution to the cirrus clouds of our own atmosphere.

MARS

Crossing the earth's orbit, we come to planets which are colder than our own. Mars, which comes first, is not enormously colder, its average temperature being about −40° C. Actual temperatures are fairly widely spread about this average, those observed ranging from + 10° C. (summer afternoon on Martian equator) to − 70° C. (polar regions in winter).

The fact that the temperatures are not more widely spread suggests that Mars must be surrounded by a very substantial atmosphere, and observation confirms that this is so. W. H. Wright of Lick Observatory photographed the planet in infra-red light, which penetrates any atmosphere there may be and so photographs the solid body of the planet, and also with ultra-violet light, which has very little penetrating power and so photographs the surface not of the planet but of its atmosphere. He found that the ultra-violet image was measurably larger than the infra-red image, and thus obtained clear proof that Mars has an atmosphere, which he estimated to be from 50 to 60 miles high.

We still know very little of the constitution of this atmosphere. Spectroscopic analysis so far finds no definite evidence of either oxygen, carbon dioxide or water vapour. The rather insensitive test for water vapour merely shows that there cannot be a tenth as much water vapour per square yard as in our own atmosphere.

The two poles of Mars are surrounded by white areas, generally known as "polar ice caps", which diminish in size in warmer weather and disappear almost entirely in summer. They were so named from analogy with the ice-caps on our own planet, but their true nature is probably revealed by the photographs of W. H. Wright, already mentioned. The caps are found to show very clearly in ultra-violet light, but are almost invisible in infra-red light. The only possible inference would seem to be that the caps are merely atmospheric phenomena. They may well consist of clouds of small solid particles, like the clouds which cover the surface of Venus.

The want of oxygen and carbon dioxide in the atmosphere of Mars suggests that this planet also resembles Venus in not possessing vegetation of the kind we know on earth. There are, nevertheless, certain dark areas on the surface of the planet which vary unmistakably, both in colour and extent, as the seasons change. In the past these variations were frequently adduced as evidence of the presence of growing vegetation, but in the light of our present knowledge it seems more reasonable to assign meteorological causes to them—possibly the falling of rain on a desert of volcanic rock or ash.

Thus the general picture we form of Mars is that of a larger and colder moon, which, because of its somewhat greater size and mass, has retained something of an atmosphere, and may still have rains, cloud and fog to vary its appearance.

THE OUTER PLANETS

Mars is the last planet on which a solid surface can be seen. Apart from Pluto, about which we know almost nothing, all the planets beyond Mars are much more massive than the earth, and as they are also much colder we should expect them to retain deep atmospheres, as detailed studies make it clear they do.

Wildt estimates that the atmosphere of Jupiter has a depth of 6,000 miles, with an average density of 0·78. For Saturn the figures are 16,000 miles and 0·41, so that the atmosphere occupies more than four-fifths of the whole volume of the planet.

The greater part of both atmospheres will be at a pressure of more than a million terrestrial atmospheres. Under such pressures, no known substance remains gaseous, so that what we have called the "atmospheres" of these planets must mainly consist of solids and liquids. Also, under such pressures, most substances become denser than water; the principal exceptions are hydrogen, helium, methane (CH_4), ethane (C_2H_6) and ammonia (NH_3). The low density of the "atmospheres" of Jupiter and Saturn suggests that they must consist largely of these substances. Hydrogen and helium, which it is not possible to detect by spectroscopic means, probably figure largely in both atmospheres, because they are abundant in the outer layers of the sun; both planets have ample gravitational power to retain them with ease, even at very high temperatures. The only substances which spectroscopic examination discloses are methane, which occurs in profusion, and ammonia, which is not found to occur in any great quantity. It is remarkable that these two gases account for absolutely the whole of the absorption of light observed in the atmospheres of Jupiter and Saturn. If other constituents are present, they are either in amounts too small to be observed or else, like hydrogen and helium, make no spectroscopic impression on light passing through them.

Still farther away from the sun come Uranus and Neptune, which prove to be merely colder miniatures of Jupiter and Saturn. The observed temperature of Jupiter is − 138° C. and of Saturn − 153° C.; the temperature of Uranus is certainly lower than − 183° C. and that of Neptune probably lower still, perhaps about − 210° C.

In their general structure the two planets are clearly similar to Jupiter and Saturn; the spectra of their atmospheres are also similar, both showing a great abundance of methane, although ammonia has not yet been detected—possibly the extreme cold has frozen it out.

We can now try to form a physical picture of the system of planets as a whole. Leaving out Pluto, because we know nothing about it, and reserving Venus and the earth for later discussion, we see a sequence of planets—Mercury, Mars, Jupiter, Saturn, Uranus and Neptune—in which the physical conditions vary continuously as we pass along the sequence. We find heat giving place to cold, absolute aridity to an abundance of water or ice, while the atmospheres increase in depth and extent and hydrogen probably increases from nil to a large amount, existing in the form either of free hydrogen or of its compounds, especially methane.

The reason why the twin planets, Venus and the earth, do not altogether fit into this sequence is in part because they are more massive than their immediate neighbours Mercury and Mars, and so retain more atmosphere. After allowing for this, Venus fits into the sequence fairly well, but the earth still remains anomalous in having so much oxygen and water vapour in its atmosphere. This is probably a consequence of its clothing of vegetation; life has come to the earth and thrown it out of its place in the regular sequence.

Not long ago it used to be thought that the sun was continually cooling and the planets with it. What the earth now is, it used to be said, Mars must have been in the not very remote past and Venus will be in the not very remote future. If the earth is the only planet on which life now exists, Mars may nevertheless be the planet of spent life and Venus the planet of life yet to come. Our recently acquired knowledge of stellar structure and stellar evolution requires a substantial modification of this view. The sun obtains its energy from subatomic re-arrangement of its substance, light elements combining to form heavy ones, but so long as the supply of light elements does not give out entirely, the effect of these chemical changes on the sun's mechanical structure and on its outpouring of energy is extremely slight. Thus Mars must have had its present chilly temperature since those remote days when it was still warmed by the heat it had brought from the sun, and Venus will retain its present heat until the sun's supply of light elements becomes used up and it collapses into a cooler and smaller "white dwarf". This being so, the idea that life can progress along the planetary sequence is probably illusory. The earth is the planet of life because it is at the right distance from the sun, but there is no justification for thinking either that life of the kind we know on earth once existed on Mars or that it will in due course appear on Venus; these planets are at the wrong distance from the sun.

INDUSTRIES OF THE CROMER FOREST BED

BY J. REID MOIR, F.R.S.

CLEMENT REID, in his well-known description of the deposits of the Cromer Forest Bed in Norfolk, states[1]: "Both the fauna and flora, leaving out the large mammals and other extinct forms, are curiously like that of the 'Broad District' of Norfolk at the present day; and this, like the rest of the evidence, points to a wide alluvial plain with lakes and sluggish streams, bounded on the west by a slightly higher sandy country covered with fir-forests and distant from any hills." The climate of this pleasant hunting country, now obliterated by the North Sea and great thicknesses of glacial deposits, was evidently genial, and we may suppose very suitable for the primitive people inhabiting the region in those remote days. It is, in fact, somewhat difficult to imagine a terrain, rich in wood, flint of first-class quality, and big game, more suitable for the successful activities of the men of the Old Stone Age, and researches carried out in recent years have demonstrated that a succession of races of these people lived in the valley of the ancient Rhine.

Some years ago, I was able to establish that five different periods of human flaking on flints were present in the Suffolk Bone Bed beneath the Red Crag of Suffolk[2], thus extending very considerably the duration of man's existence in the Pliocene epoch. Now I am able to announce that no less than *seven* periods of artificial flaking of flints are present in the basal layer of the Cromer Forest Bed. This, if my conclusions are found to be accurate, means that the duration of man's existence in the Early Pleistocene epoch must also be extended considerably.

The manner in which it is possible to distinguish different periods of flaking upon flints is quite simple, and in most cases irrefutable. A flint implement in the course of time—almost certainly prolonged—has, under natural conditions, become patinated and stained. Its flake scars exhibit a very definite coloration—for example, a dark mahogany brown—and at one or more places this flaking has been cut into by later fractures and these may be of a white, blue or other colour. When, moreover, it is found that the deposit under examination contains assemblages of flint implements differing from each other in their morphological details, and exhibiting patinations comparable with those observed upon the re-flaked specimens, it is evident that we are dealing with artefacts of different ages, made by a succession of races of prehistoric people. The various groups of implements discovered in the Suffolk Bone Bed at one time lay either on, or in, a pre-Crag land surface which was broken up and redeposited by marine action, and in the case of the basal layer of the Cromer Forest Bed, now to be considered, a comparable explanation is postulated.

At certain sites along the north-east coast of Norfolk, this basal layer is exposed either at the foot of the cliffs or upon the foreshore at low tide. The deposit is a very hard ferruginous bed composed of sand, large numbers of flints, and in places marine shells and the remains of terrestrial mammals. Where the bed is present upon the foreshore, it is gradually broken up by wave-action, which washes away the sand matrix and leaves the harder constituents—flints, bones, etc.—upon the underlying surface of chalk.

It is from the large 'sporads' of flints thus formed that considerable numbers of artefacts have been recovered, but many other comparable specimens have been found in the basal layer where it is *in situ* and undisturbed. The seven groups of humanly flaked flints discovered in the basal layer of the Cromer Forest Bed may be described, briefly, as follows:

(1) Specimens exhibiting either a purplish colour with chestnut brown areas, or the well-known 'blacklead' patination. The predominant form is a coarsely flaked hand-axe. Rostrocarinates occur and many striking examples of transitional rostrate hand-axes. There are also racloirs, choppers, scrapers, and points. The specimens tend to be massive in size and are often severely striated and abraded.

(2) Reddish-brown specimens composed largely of flakes of considerable size showing prominent bulks of percussion, and when present, flat striking platforms. A few large core pieces and some borers and scrapers. Flints very seldom exhibit striations, or the amount of abrasion seen on the specimens of Group 1. Hand-axes and rostrocarinates are very rare.

(3) Ochreous-yellow specimens almost entirely composed of flakes generally less in size than those of Group 2 and exhibiting smaller bulbs of percussion. A few racloirs and scrapers. Striation negligible and little abraded.

(4) A small series of greenish-yellow specimens comprising steep-faced scrapers and points. Flakes very rare. Flints exhibit no striations but some signs of rolling.

(5) Specimens of a cream or white colour.

Numerous flakes usually exhibiting small bulbs of percussion. Some fine racloirs, broad scrapers and points. One racloir shows two adjacent bulbs of percussion, and the cutting edge formed by 'resolved' flaking. Some striations but little abrasion.

(6) Blue flakes, some showing signs of use, tending to be large with some well-formed bulbs of percussion. No striations or abrasion.

(7) Black, unchanged flakes, some showing signs of use, and smallish bulbs of percussion. No striations or abrasion.

The above groups are arranged in what appears to be their respective ages as shown by the re-flaked specimens and indicate that in Early Pleistocene times an industry rich in primitive hand-axes, rostrocarinates and transitional forms was followed by a succession of what must be regarded, on the evidence at present available, as flake industries in which core implements are, to all intents and purposes, absent. The presence of hand-axes in Group 1 makes it advisable to refer all these industries to early Palæolithic times, while those in the more ancient Bone Bed of Suffolk, which differ very markedly in many respects from the Forest Bed artefacts, and in which hand-axes are of an exceeding rarity, are to be relegated to the Eolithic period.

In the Estuarine Bed above the basal layer of the Cromer Forest Bed a few artefacts have been found, chiefly by Mr. J. E. Sainty, who has given me invaluable help in my investigations. These specimens are of somewhat primitive types and their flake-scars exhibit, usually, a shiny black coloration, and are derivatives in the Estuarine Bed. The Upper Freshwater Bed, above the latter accumulation, has, so far, yielded no recognizable flint artefacts.[2] A representative series of the Cromer Forest Bed industries has been arranged in Ipswich Museum. The research was carried out under the auspices of the Royal Society and the Percy Sladen Memorial Fund.

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[1] "The Geology of the Country Around Cromer" *Mem. Geol Survey* p. 61.

[2] *J. Roy. Anthrop. Inst.*, July–December 1921.

CHEMICAL SUBSTITUTES FOR DIETARY PROTEIN

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INTRODUCTION

UNDER present war-time conditions the protein supply of the nation is of paramount importance. The problem of finding substitutes for dietary protein, therefore, in the form of simple nitrogenous compounds of a non-protein nature, capable of industrial synthesis, opens up new possibilities in war-time economy. The aim of this discussion is to show that this problem has reached a practical stage.

Experiments have been carried out over a period of years in various countries, investigating the effect of urea, ammonium acetate, ammonium bicarbonate, glycine, asparagine, succinamide, and other similar substances. These experiments were designed to ascertain the result of this 'amide' substitution on :

(*A*) Dairy cattle and goats (for milk production).
(*B*) Heifers, bullocks, etc. (for meat production).
(*C*) Sheep (for meat and wool production).
(*D*) Humans.

The above were all practical feeding experiments. Another series of experiments attempted to discover the mechanism by which protein substitution is brought about.

(*A*) DAIRY CATTLE AND GOATS (FOR MILK PRODUCTION)

Ziemer and Ehrenberg fed goats and milk cows with ammonium bicarbonate in conjunction with acid sugar beet slices, sour whey, and silage (that is, with the ammonium salts of the organic acids present in these feeding stuffs), replacing protein nitrogen by equivalent amounts of ammonia. Extra starch was given to make up the calorific value of the ammonium bicarbonate.

With goats ammonium bicarbonate was able to replace 50 per cent of the food protein for milk production. With milk cows up to 76 per cent of the production protein could be replaced by equivalent amounts of ammonium bicarbonate, which, whilst not reaching completely the effect of good oil-cake food, proved a satisfactory substitute, provided that it was fed in conjunction with a suitable commercial or home-grown starch supplement. However, the extent to which ammonium bicarbonate was utilized was influenced largely by the individuality of the animals ; cows with more than three gallons milk yield not responding very well to the ammonia feeding. The composition of the milk remained perfectly normal in the ammonia-fed animals.

Similar experiments with urea and glycine showed that, in terms of milk production (4 per cent fat content), the efficiency of urea and glycine was about 40 per cent and 30 per cent respectively that of the oil-cake.

Richter and Herbst, also working with urea and glycine, obtained a reduction in milk yield when the replacement of production protein by 'amides' reached 50 per cent.

Eventually mass experiments were conducted by the German *Forschungsdienst*, according to a common experimental plan, in which the protein demand for about two gallons of milk was covered by 'amides'. In general, the 'amides' were found to possess half the efficiency of protein. Therefore a *Wertigkeit* (complementary value) of 50 was allotted to the urea nitrogen. These results led finally to the commercial manufacture of the amide oil-cake mixed concentrate (*Amidoelkuchenmischfutter*) by the German I.G.

(*B*) CATTLE (FOR MEAT PRODUCTION)

In experiments by Fingerling *et al.*, two nine-months-old bullocks had the gluten of their production ration replaced by equivalent amounts of urea, with the result that nearly the same nitrogen-balance was obtained as before. The relative retentions of gluten and urea nitrogen in the total protein, expressed as a percentage of the total nitrogen absorbed, were calculated as 61·7 per cent and 55·8 per cent respectively. When during a subsequent period only the minimum maintenance protein was fed, a sharp drop in the nitrogen retention occurred, proving that the amount of nitrogen retained in the urea period could not have been due to the maintenance protein. The authors, therefore, conclude that the nitrogen of urea can be utilized within fairly wide limits by the growing animal. Hence, they advocate the introduction of urea as a protein substitute into agricultural practice.

Bartlett and Cotton at Reading tested the effect of urea on dairy heifers 7–12 months old by replacing one-third of the protein ration with the 'amide'. Body measurements, handling properties, fatness etc., were observed. No significant differences were found between the 'amide' fed and protein fed animals. With regard to live-weight increases the conclusion was reached that animals receiving nitrogen over and above the low protein level in the form of protein showed better live-weight gains than those receiving the same quantity in the form of urea. The differences, however, were statistically not significant.

In a Rhodesian experiment, by Murray and Romyn, the live-weight increases of Red Poll heifers over a period of ninety-three days was found to be approximately the same by feeding equivalent amounts of urea as by feeding peanut cake.

In America, Hart, Deobald and Bohstedt experimented with four calves, the first receiving a low protein ration, and the others getting the same feed plus urea in the second, ammonium bicarbonate in the third, and casein in the case of the fourth calf. The live-weight gains were 65, 105, 110 and 126 lb. respectively, again confirming a considerable utilization of 'amides'.

(*C*) SHEEP (FOR MEAT AND WOOL PRODUCTION)

Among the more recent experiments in this field there are the investigations with growing lambs by Nehring and Schramm, who replaced one-third of the total nitrogen by urea, glycine and ammonium acetate respectively. Whilst the nitrogen-balances were negative in the basal and low protein periods, they became positive in the 'amide' periods, reaching a maximum with ammonium acetate.

In this connexion mention should be made of various criticisms advanced by some workers against these positive results. For example, the question of excretion of ammonia via the lungs and intestinal gases has been raised. This was investigated by Nehring and Schramm, by Scheunert and by Sauer, with absolutely negative results. Further, the possibility of a mere *flooding* of the blood and organs by the 'amides' has been suggested. This criticism was based on increases in 'rest' nitrogen in the blood of 'amide' fed animals. But whilst these increases amounted to one or two grams over a period of *several weeks*, there was a *daily* nitrogen retention of 2–3 gm.

Nehring and Schramm also tested the effect of dried beet slices plus urea, and of molassed bran plus urea, as part of the previously mentioned German mass experiments. The conclusions were :

(1) The experiments with the two preparations showed that up to 200 gm. of urea per day could be fed without any ill-effects.

(2) The digestibility of the two feeding stuffs was very high, and apart from the urea it was 82 per cent and 85 per cent respectively.

(3) The feeding of the two 'amide' preparations caused an improvement in the nitrogen-balance. As compared with the basal period with hay there was a retention of 2–3 gm. of N. more in the slices, and 1 gm. more in the bran.

Very similar results were obtained by Mangold and Stotz, who experimented with linseed cake plus urea, and with potato flakes plus urea. The percentage of urea in both preparations was about 15 per cent.

Further, Liliencron, feeding glycine to lambs for 150 days, obtained very satisfactory results. Similarly, Kirsch and Sauer, studying the effect of different 'amides' on growing sheep, when 20–30 per cent of the nitrogen was replaced, found no differences between the normal and urea groups with regard to live-weight gain and wool production.

The most conclusive experiment of all, however, was reported by Nehring and Schramm in 1939. Four groups of animals were used. In one, protein was fed in adequate amounts (normal group), in the second, one-third of the crude protein or one-half of the digestible crude protein was left out (deficient group), and in the third and fourth groups this one-third was replaced by equivalent amounts of urea and glycine (amide groups).

This is the first experiment in which both nitrogen-balances and live-weight gains were recorded and related to each other by recalculating the nitrogen retention into live-weight gains with very good agreement. The sulphur-balances, following closely the result of the nitrogen-balances, confirmed the anabolic utilization of the nitrogen retained.

The results can be summarized in the accompanying table :

	Groups			
	Normal	Deficient	Urea	Glycine
N retention in gm./day ..	4·87	3·13	4·86	4·90
S ,, ,, ,, ..	0·519	0·342	0·379	0·432
Daily live-weight gain in gm.	102·5	75·4	93·0	101·0
Live-weight gain minus wool increase in gm./day ..	93·2	63·8	82·8	89·6
Live-weight gain calculated from N retention minus wool N in gm./day	100·1	53·8	97·2	99·4

These results of the nitrogen investigations, supported by the determination of the sulphur-balance and related to the results of live-weight gains, are regarded as proof that 'amide'-like substances like urea and glycine can be utilized in the growing ruminant under certain conditions in place of protein for the production of new body substance.

Experiments, which gave negative results, but which were in the author's opinion invalidated by various flaws, have been omitted for the sake of brevity.

(*D*) Humans

Whilst in the ruminant a definite retention of non-protein nitrogenous compounds has been established, the question of a retention of non-protein nitrogen in the human is completely unsettled, and although results hitherto obtained are contradictory and inconclusive, they seem to point to a negative answer. This agrees with the evidence on the mechanism of non-protein nitrogen utilization, put forward in the next section.

Influence of Micro-organisms

As far back as 1843 the view was expressed that Infusoria might have a special nutritional significance. Later, Pasteur and A. Mayer succeeded in forming protein of micro-organisms in yeast moulds from ammonia. These results were confirmed by M. Mueller with asparagine and ammonium hydrogen tartrate, by showing that rumen bacteria prefer these substances to protein for anabolic purposes, thereby producing considerable quantities of protein. Zuntz interpreted these results by assuming that 'amides' could be used by the ruminant by way of assimilation by bacteria in the rumen, and their subsequent digestion in the truly enzymatic digestive tract (Zuntz's bacteria hypothesis).

In 1920, on the basis of extensive experiments, Voeltz concluded that urea can assume the role of food protein in the metabolism of the ruminant, whereby urea is first built up into bacterial protein in the digestive tract, 80–90 per cent of which is afterwards absorbed from the intestines.

The first quantitative data on the problem were supplied by Schwarz, who found that the nitrogen of the bacteria and infusoria accounted for 11·7 and 20 per cent respectively of the total nitrogen content of the rumen. He calculated the weight of micro-organisms per 100 kgm. rumen content as 2·79 kgm., which contains 41 gm. of nitrogen, corresponding to 256 *gm. of protein*, 80–90 per cent of which can be utilized, according to Voeltz. The protein requirement of the ruminant, however, is put at 0·6 lb. per 1,000 lb. live-weight, corresponding to 272 *gm. of protein*. There is, therefore, stored in the micro-organisms a sufficient amount of protein for covering the protein requirement of the animal. Unfortunately, the crucial point, whether there is an increase in the micro-organic nitrogen of the rumen during 'amide' feeding has never, to my knowledge, been *directly* investigated.

With regard to the question of the subsequent digestion of the bacterial protein formed in the rumen, Bruner showed that a glycerol extract of pancreas, containing trypsin, dissolves Gram-negative, but not Gram-positive bacteria. Pepsin, amylase and lipase show no distinct effects on the two groups of bacteria. Therefore it seems possible that not only does the bacterial synthesis in the rumen depend on variable conditions, but that also the bacterial protein thus formed can be digested to a variable degree by the digestive enzymes.

Research into the creation of favourable conditions for protein synthesis is, therefore, *imperative*. It is obviously necessary to influence the activities of the rumen micro-organisms, so that within natural limits protein bricks of all necessary kinds in the right proportions are manufactured in order to ensure the synthesis of a corresponding amount of milk, meat, wool, etc. This is clearly linked up with the whole question of protein make-up, biological values, etc.

Very interesting are the results of Klein and his co-workers, who on the basis of the results of metabolism experiments and from the mycological and metabolic changes of the rumen paste and of the fæces, concluded, that in certain protein-deficient combinations in the rumen, protein can be synthesized from the nitrogenous fractions of 'molasses-amides'.

A further contribution in this connexion are the experiments by Lenkeit and Becker on the fate of the urea of 'amide-flakes' in the rumen. Two series of experiments were carried out, one *in vivo* and one *in vitro*. In the former, the decomposition of urea into ammonia and carbon dioxide was instantaneous, but in the latter, working with rumen extracts, it could be followed analytically. There was a progressive decrease of urea nitrogen and increase of ammonia nitrogen, leading to the complete decomposition of the urea after twenty-four hours. *But* 10–20 *per cent of the original urea nitrogen does not appear in the form of ammonia.* The explanation of this fact probably lies in the fixation of ammonia nitrogen in the metabolism of the animal or in the micro-organisms present.

CONCLUSION

This whole problem of 'amide' substitution is, therefore, a very important one, especially in present war-time conditions, although it might even be considered in peace-time as a means of reducing the cost of the most expensive constituent of the production ration, namely, protein.

Under war-time conditions it appears essential to be able to feed for production purposes with substances which can be produced synthetically at home at a reasonable price. These 'amides' have, however, to be fed in conjunction with suitable foods. This problem has already been largely solved in Germany, where four preparations are manufactured industrially:

(1) Dried beet slices with urea solution.
(2) Molassed bran with addition of urea.
(3) Linseed meal with urea.
(4) Potato flakes with urea.

In this connexion the following suggestions are offered:

(1) We in Great Britain could make immediate use of all the results of the German experiments, without going through the tedious processes through which they have gone.

(2) Although it took a war to impress the importance of silage-making upon the British farmer, in the case of 'amide' substitutes he would just receive the ready-made feeding-stuffs (like any other cake) from industry, and therefore the inertia of the farmer would be more easily overcome than in the case of silage, which he has to produce on his own farm.

(3) Ammonium salts can be fed in conjunction with silage, a fact very significant in view of the introduction of silos on to many British farms.

(4) It should be the task of the industrial chemist to find cheap methods of synthesizing the various 'amides'.

(5) Bacteriological research should ascertain the optimum conditions for protein synthesis in the rumen, as well as find the particular groups of bacteria best suited for the purpose. The synthetic feeding stuffs could then be *inoculated* with these strains, and thus it might be found possible to feed even more concentrated 'amide' foods than the Germans were able to use. That this idea is a very practicable one is shown by the opinion, expressed by many workers, that the bacterial activities in the rumen occur first and foremost under the influence of bacteria *ingested from the outside.*

(6) The enormous saving in shipping space which could be attained by the use of synthetic 'amide' foods should be strongly emphasized. Even assuming the complementary value of 'amides' to be only 50 per cent, a 50 per cent reduction in shipping space would be effected, since, instead of 100 parts of cake, 50 parts of 'amides' plus 50 parts of cake could be fed.

We have, therefore, in this problem a unique opportunity for the industrial chemist, the theoretical scientist, that is, biochemist and bacteriologist *and* the practical agriculturist, that is, stock-feeder and dairyman, to co-operate in the solution of a problem which is vital for the feeding of the nation, and therefore for the successful prosecution of the War.

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OBITUARIES

Sir Frederick Banting, K.B.E., F.R.S.

MAJOR SIR FREDERICK BANTING died in Newfoundland on February 21. He was on his way to England "on a mission", as the Prime Minister of Canada has said, "of high national and scientific importance". The pilot of the American bomber in which Banting was flying attempted a forced landing after the development of trouble with the engines, and in the resulting crash Banting and two of the crew members received injuries which proved to be fatal. In his death the Empire has lost one of its most distinguished citizens and the human race one of the greatest benefactors of our time. Canada could ill afford to lose him. There was no more important figure than his in our general war effort.

Frederick Grant Banting was born in Alliston, Ontario, on November 14, 1891, of Irish and Scottish ancestry. After receiving his preliminary education in the public and high schools of Alliston, he began his medical course at the University of Toronto in 1912. He enlisted as a private soldier in 1915, but was ordered back to finish his university training. He completed his medical course in 1916 and immediately joined the Canadian Army Medical Corps. He proceeded to France and was wounded at Cambrai in September 1918. He received the Military Cross for valorous conduct during the Cambrai engagement.

In 1919 and 1920 Banting served as resident surgeon in the Hospital for Sick Children, Toronto. He then moved to London, Ontario, where he began to build up a practice. He spent part of his time as research assistant in the Department of Physiology of the University of Western Ontario. In the course of the preparation of a lecture on diabetes the idea which was to change the course of his life presented itself. Banting was determined that this idea should receive an adequate trial and on the advice of his associates interviewed Prof. J. J. R. Macleod in the University of Toronto. In his lectures on carbohydrate metabolism to his senior students during the academic session of 1920–21, Prof. Macleod outlined Banting's hypothesis, and while he fully appreciated the difficulties of such an investigation he did feel that adequate opportunities for a trial should be provided. The work was begun on May 16, 1921, in collaboration with myself. The actual results of the experiments are recorded in our notebooks and in our published articles ; but the memories of that intimate association during the spring, summer and autumn in 1921 are now difficult to describe. Banting was always happiest when the investigations demanded great mental and physical activity. In these circumstances the days were always too short and continuous observations for several days and nights were not infrequently made. There is no doubt that his dogged perseverance was a highly important factor in the success which attended the insulin investigations. Banting always retained that freshness of mind and modesty of bearing which characterized him when he was conducting his first researches. These qualities were blended with an iron determination and an exceptional measure of courage to produce a character which will be vividly remembered by all who knew him intimately.

After the discovery of insulin a great many pathways were open to Banting. He would have had no difficulty in becoming a successful diabetic specialist. He often mentioned the possibility that he would return to the practice of surgery. Many institutions placed their facilities at his disposal, but he was steadfast in his determination to remain in Canada and probably always intended to spend at least a part of his time in medical research. His active interest in the clinical applications of insulin was shortlived and he soon turned his attention whole-heartedly to physiological problems. He did excellent work while investigating the functions of the suprarenal cortex and in several other intensive studies. It is greatly to his credit that after the initial dramatic discovery he was able to content himself for prolonged periods with programmes of research which promised no immediate results of practical value.

Banting directed and actively participated in cancer research for many years, and he was very proud when the experts in this field stated that his group was making a substantial contribution. Nothing gave him greater pleasure than to spend his time in experimental work which demanded his full attention. He often regretted that he could not spend more of his time in this way.

Banting was probably one of the few medical men of science in the Empire who actually made preparations for war researches well before the outbreak of hostilities. He was almost entirely responsible for the inception and organization of the researches in aviation medicine which have been carried out under the auspices of the National Research Council of Canada. His energy and enthusiasm in this work knew no bounds. He demonstrated an organizing ability which astonished even his intimate friends. Canada's war activities along medical lines owe much to the stimulus which it has received from Banting's efforts. It is probable that his last work will rank among his greatest achievements.

Banting appreciated deeply the honours which were showered upon him, but nothing diverted him from the development of medical research in Canada. He thoroughly enjoyed vacations, during which he was able to give scope to his talent for transferring the beauties of the Canadian landscape to canvas, but these periods away from his laboratory were always short. He had gathered around him a group of active young workers whose efforts have already been rewarded by a considerable measure of success. Their chief was keenly aware of all the difficulties in the problems which he asked them to attack. He was inclined to be intolerant of those who favoured the leisurely approach and felt that a research worker should throw himself heart and soul into the struggle. His philosophy of life was that men are prevented from reaching their goal by their inability to "think and work hard enough and long enough".

During the last few years Banting had the opportunity of becoming intimately acquainted with most of the active workers in medical research in Canada and of studying their methods in their laboratories. His passionate devotion to the open-minded experimental approach to medical problems and his ability to communicate his enthusiasm to other people will be dominant factors in the development of this work in Canada for many years to come.

C. H. BEST.

Dr. J. Rendel Harris

WE regret to record the death of Dr. J. Rendel Harris, Biblical scholar, archæologist and orientalist, which took place at Selly Oak, Birmingham, on March 1 at the age of eighty-eight years.

James Rendel Harris was born in 1852 and educated at Weymouth Grammar School and Clare College, Cambridge, of which he became a fellow and lecturer after he had graduated as Third Wrangler in 1874. Although a mathematician—he served as moderator and examiner in the Mathematical Tripos—he turned to Biblical and patristic studies, to which he became ardently devoted, rapidly attaining an outstanding position in textual criticism. In 1882 he left Cambridge for the United States, where he remained for some years, holding the chair of New Testament Greek in Johns Hopkins University, Baltimore, and later that of Biblical languages at Haverford College, Pennsylvania.

In 1893, Harris returned to Cambridge, and for ten years he was University lecturer in palæography, travelling extensively the while in the East in search of manuscripts. His success in this field of research, combined with his profound scholarship, bore fruit in notable and lasting contributions to Biblical and Syriac studies. After a brief tenure of the professorial chair of theology at Leyden he became director of studies at the Settlement for Social and Religious Studies of the Society of Friends at Woodbrooke, near Birmingham.

At Woodbrooke, Harris continued his studies in Syriac, but turned in an increasing degree to research in anthropology and folk-lore, devoting himself more particularly to the examination of early Mediterranean cults and their relation to forms of popular and other beliefs in the Christian Church. In "The Cult of the Heavenly Twins" (1906) and "Boanerges" (1913), the former dealing with the legend of the Dioscuri, he showed, with a wealth of comparative illustration and much detached evidence, that many of the pairs of saints in the Christian calendar could be traced back to a connexion with a cult of the Great Twin Brethren. Further studies on analogous lines, issued separately, dealt with the cults of Dionysos, Apollo, Artemis and Aphrodite; two major works were "The Ascent of Olympus" and "Picus who is also Zeus".

Prof. Richard Bär

SWISS physics and Swiss physicists suffered a severe loss, when, on December 13, 1940, Prof. Richard Bär died in his home in Zurich (where he had been professor of physics in the University)—a home whose hospitality many of his colleagues from all parts of the world will remember, having passed the friendly town on pleasure trips to the Alps and having met there not only with the friendliest reception but with one of the most distinguished of Switzerland's learned and literary circles.

Only now, after his premature death, it has been known how lavishly R. Bär had used his wealth to alleviate the lot of the distressed—in the first place of those uprooted by any kind of spiritual intolerance. He had a sort of shyness of giving and would, ostensibly, deny his assistance but send the applicants to a friend of his, pretending that his friend was in charge of an ample assistance fund (which he actually was, but the fund was supplied by R. Bär). I am told that the reception of about thirty displaced scholars at Istanbul was mainly due to R. Bär's initiative, who seized the prospect as soon as it turned up and arranged matters by a personal visit to Istanbul, to which he invited two influential friends.

To most physicists R. Bär is best known by his vigorous and fully successful attempt to disprove by clear and decisive experiments the doubts which F. Ehrenhaft (Vienna) had thrown on the reality of the "elementary quantum of electricity". The doubts were serious, and a detailed experimental refutation was needed to support our theoretical convictions. His later work included important discoveries in the domain of electrical discharge through gases, of the Raman effect and of ultra-sonic waves. It was right in the middle of very beautiful results on the latter phenomenon—diffraction of light by a liquid that is permeated by ultra-sonic waves and thereby turned into a diffraction grating—that his untimely death has occurred. To all this work of his a singular fact, which seldom occurs, gave a peculiarly inspiring tinge: he had begun as a pure mathematician (he had been David Hilbert's assistant during 1916–17) and ended up as an experimental physicist.

ERWIN SCHRÖDINGER.

WE regret to announce the following deaths:

Prof. C. G. Cullis, professor of mining geology in the Royal School of Mines (Imperial College of Science and Technology), on April 27.

Mr. Francis Druce, the well-known botanist, hon. treasurer of the Royal Meteorological Socity during 1913–18 and 1925–32, and of the Linnean Society during 1931–40, by enemy action.

Prof. F. Francis, emeritus professor of chemistry in the University of Bristol, on April 15.

Mr. Hans G. P. Meier, librarian of the Warburg Institute, by enemy action.

Miss J. A. Paterson, librarian of Bedford College for Women (University of London), by enemy action.

NEWS AND VIEWS

The Democracies and Honour

By means of the radio, Mr. Winston Churchill and General Smuts, who will surely go down in history as two of the leading statesmen of these days, recently gave addresses which will mark, possibly the close of a stage, possibly the opening of a new period of activity, in the progress of the War. Mr. Churchill gave a careful and moderately worded survey of the present position in the Balkans, North Africa and the Atlantic. He did not minimize the difficulties of the situation, but he made it quite clear that we could not have done otherwise than we did in answering the call of Greece; to have left Greece to her fate "would be fatal to the honour of the British Empire, without which we could neither hope nor deserve to win this hard war". It is by actions such as this, and by our bearing under the pitiless rain of blows aimed at our cities and our merchant ships as well as at our armed forces, that we have gained the admiration and support of the people of the United States, and in spite of all the arguments about American interests and safety being threatened by Nazi doctrines, "the action of the United States will be dictated not by methodical calculations of profit and loss, but by moral sentiments and that gleaming flash of resolve which lifts the hearts of men and nations, and springs from the spiritual foundations of human life itself".

By the honourable discharge of our obligations to the utmost of our available power, we have encouraged the peoples of the Balkans, and others as well, to believe in the good faith of the democracies. Whereas the Germans, Mr. Churchill said, have made "a river of blood and hate between themselves and the Greek and Yugoslav peoples", the British Empire has won admiration and sympathy. As General Smuts put it: "Great Britain has been investing in friendships, as Germany has been investing in hatreds in the process of war, and Great Britain has thus been building up the moral capital with which the real new order will be floated after the peace". Both speakers urged the need for a just appreciation of the significance of events in the Mediterranean area, but stressed that the vital theatre of war is in the West, in Britain and on the Atlantic, where the recent extension of the American neutrality patrol has given us most valuable assistance.

Aircraft Production

Speaking in the House of Lords, in reply to a request from Lord Sempill, Lord Beaverbrook recently disclosed several facts of technical interest with regard to R.A.F. equipment. One significant statement was that the Napier 'Sabre' engine has proved successful and is in production, both in Great Britain and the United States. This engine was put into production without going through the usual period of testing—a procedure contrary to all normal peace-time practice. It was designed by Major Halford, and develops a horse-power of 2,400. It is at present being fitted to the Hawker-Siddeley 'Typhoon', a new fighter capable of a speed of more than four hundred miles an hour, with a greater range than any previous single-seater type. Aircraft from the United States, including the new 'Catalina B.P.Y.' flying boat, the Curtiss 'Tomahawk', the Boeing 'Flying Fortress' and entirely Canadian built 'Hurricane' are now being received in quantities, nearly a thousand to date, and the air ferry system, by which many are delivered by air across the Atlantic, will soon be extended so that fighters as well as bombers may be sent in this way. Such journeys have been made in 7½ hours, coast to coast, compared with 20 hours, the schedule time for the American Clipper to Lisbon. The fact was disclosed that the only aircraft that has been lost during this service was unfortunately one that was carrying Sir Frederick Banting as a passenger (see p. 535 of this issue).

The development of a new high explosive bomb is proceeding successfully, and recently Squadron Leader Garner, one of the officers responsible for the technical side of this work, flew over the town of Emden with the "greatest bomb that has ever been dropped from an aeroplane", observing the effects for himself. The supply of raw materials, and equipment such as guns, navigation instruments, radio apparatus, etc., has given anxiety, but is improving. Most aircraft and aero-engine manufacturers have agreed that their demands for materials are now being satisfied, but it is admitted that a certain equipment shortage still exists. The dispersal of production centres, as an antidote to enemy bombing, is claimed to be a success. One plant, until recently on a single site, is now dispersed to forty-two centres in five different counties, and at the same time duplicate production of each item has been arranged so that the loss of any one plant cannot entirely hold up production of a unit.

Scientific Liaison with America

In a written reply to a Parliamentary question on April 29, Mr. Butler, Under-Secretary for Foreign Affairs, said: "After consultation with the appropriate authorities in the United States, His Majesty's Government have drawn up a comprehensive scheme, which has already been put into operation, for co-operation in scientific matters with the United

States of America. His Majesty's Government have selected and sent Dr. Darwin, the director of the National Physical Laboratory, as director of a Central Scientific Office, working under the direction of the British Supply Council in North America. Dr. Darwin's duty will be to collaborate with United States research bodies, to act as a channel for the exchange with the appropriate United States authorities of technical and scientific information, and generally to co-ordinate scientific and technical inquiries to and from the United States authorities, except in those matters which are already dealt with through the Service attachés. In addition, Dr. Conant, the president of Harvard University, recently visited England as President Roosevelt's representative in order to establish a corresponding mission in this country."

Advisory Committee on Engineering in Warfare

THE Lord President of the Council, with the approval of the Prime Minister, has appointed an Engineering Advisory Committee under the chairmanship of Lord Hankey to advise the Government upon engineering questions connected with the war effort and in particular: "To consider how the resources of the engineering profession can best be utilized in connexion with the war work of Government departments, and to nominate engineers who might suitably be invited to undertake particular tasks. To suggest means of improving or supplementing the methods adopted by Government departments for utilizing engineering science for war purposes. To advise on problems referred to them in connexion with the development of new engineering devices, and to advise on methods of bringing such devices speedily into production, and on means of meeting new war requirements in the engineering field. To examine new ideas or devices in engineering likely to assist the war effort, to test their technical validity, and to bring to the notice of the Government those which appear to merit further consideration by the department concerned."

The Committee will consist of Lord Hankey, Chancellor of the Duchy of Lancaster (*chairman*); Lord Falmouth (*vice-chairman*); Sir Henry Tizard, rector of the Imperial College of Science and Technology. The rest have been selected after consultation with the presidents of the Institutions of Civil Mechanical and Electrical Engineers and are as follows: Mr. J. R. Beard, of Merz and McLellan, consulting engineers; Dr. A. P. M. Fleming, director of the Research and Education Departments, Metropolitan-Vickers Electrical Co. Ltd.; Mr. W. T. Halcrow, consulting engineer; Prof. B. W. Holman, assistant professor and University reader in mining in the Imperial College of Science and Technology, London; Dr. C. C. Paterson, director of the Research Laboratories, General Electric Co. Ltd.; Mr. H. R. Ricardo, technical director of Ricardo and Co. Ltd., consulting engineers; Dr. A. Robertson, principal of the Merchant Venturers' Technical College, Bristol.

Post-War Problems for Chemical Industries

THERE has been an increasing tendency of late for presidential addresses to deal with topics that lie outside the scope of the scientific or technical society concerned. We have had physicists dilating upon metaphysics, chemists on agriculture, biologists on politics, and nearly all on education or economics. This practice is not to be summarily condemned, because it indicates that at least some scientific men are abandoning their old attitude of 'splendid isolation' from human affairs, though at times one is reminded of Bernard Shaw's dictum that no one ever learned to do one thing by doing something else. Mr. F. Heron Rogers, in his address to the nineteenth annual meeting of the Institution of Chemical Engineers, held on April 4 in London, proved no exception to this tendency. In his view, war is inevitable, and the 'fittest' who survive in life's struggles are those who are "strong in arms and in honour".

Probably the most serious after-war problem, says Mr. Rogers, will be that of finance, conjoined with the maintenance of our industries and finding work for all. In planning post-war industries, regard must be had for safety of buildings, etc., and this will be best attained by dispersion and by troglodytic working in caves. Great Britain must be made less dependent upon other countries for its necessities, such as mineral oils, timber and food. A calcium carbide industry is essential for producing acetylene and the numerous useful substances derivable from it, while further research on coal-tar products is needed to increase the number of useful aromatic compounds, like solvents, dyes and intermediates. Basic to our industrial life is research on the problem of eliminating sulphur, phosphorus and arsenic from carbonaceous materials, the solution of which would give an enormous impetus to the iron and steel industries and ease all our metallurgical operations. Research is also needed on the utilization of waste materials, which includes problems of extraction, dehydration, disintegration, pressure-filtering, and similar engineering processes. Given a period free of unwise governmental and political interference, and freedom from subsidized competition, great strides in which chemical engineering would play its part could be made towards post-war safety and happiness.

Psychological Terms used in Head Injuries

THE Brain Injuries Committee of the Medical Research Council, in War Memorandum No. 4 (London: H.M. Stationery Office. 1*d*. net), has compiled a short glossary of psychological terms commonly used in cases of head injuries. The object of the glossary is to secure a greater measure of uniformity in the terminology used in case-notes of patients with head injuries. There is always some difficulty in defining within fixed limits psychological terms, a difficulty that is increased by the fact that many of the terms are also used in popular speech with somewhat vague reference, for example, confusion, hysteria. When a patient suffering from a psychological derangement resulting from, or coincident with, head injury is referred by a physician to a special centre, it would be advantageous if the same meaning were attached to the same words. To further this aim sixteen words in common use have been defined. It is possible that another committee might have arrived at a slightly different phraseology, but although general acceptance cannot be expected, yet here is a very useful beginning, and the glossary will probably have a gradually widening sphere of application. Some of the terms defined are: *coma*, *confusion*, *delirium*, *traumatic stupor*, *concussion*, *malingering*, *hysteria*.

An Early Marine Engineering Institution

In *Engineering* of April 4, Eng.-Captain E. C. Smith gives a short history of the almost forgotten Institution of Marine Engineers, which existed from 1876 until 1879. It came to a close ten years before the present Institute of Marine Engineers was founded, and it does not appear there was any connexion between the two. The Institution grew out of a Registry of Sea-Going Engineers, afterwards called the Associated Marine Engineers, founded in the City of London. In January 1876, the *Marine Engineering News*, the forerunner of the present *Marine Engineer*, was founded, and the editor of this and the secretary of the Institution were one and the same person, Matthew Augustus Soul, a patent agent. Another leading figure in the activities of both journal and society was Nicholas Proctor Burgh, the writer of several books on engines and steam, on the latter of which he held some unusual views. The other promoters of the Institution were consulting engineers in the City of London. The aims of the Institution were admirable. Papers were to be read, a museum and library formed, and a provident fund started; but evidently affairs did not flourish, for both Institution and *News* came to a close in 1879, leaving little trace of their doings.

Meteorology in India

No drastic changes are indicated in the Report on the Administration of the Meteorological Department of India in 1939–40 (Pp. iii + 35 + 8 plates. Delhi: Manager of Publications, 1940. 1.2 rupees; 3*s*. 9*d*.). A start has been made on the construction of new buildings at New Delhi for the Upper Air Office, which is to be transferred to that city from Agra. Thirty acres of land have been acquired for this purpose, and the buildings were begun in December 1939; they were expected to be ready for occupation towards the end of 1940. The forecasting office at New Delhi, which was closed as a measure of economy in 1932, at a time of financial stringency, was re-opened, and at about the same time a new wireless station attached to the Poona Meteorological Office began to function. These last two developments allowed the Department to complete its "regional synoptic" scheme for the broadcasting of station weather reports. The stations included in these broadcasts, and in similar broadcasts from Karachi, Calcutta and Rangoon, are shown in plate I of the report, and those included in the "Collective Synoptics" in the same plate.

In addition to carrying on the ordinary routine work, so far as war-time restrictions permitted, special investigations were made, among which was one into the seismological features of the Satpura Range earthquake of March 14, 1938. Daily measurements of ozone in the upper atmosphere were begun at the headquarters' office towards the end of 1939 with the aid of a Dobson photo-electric spectrophotometer. Assistance was given to a scientific expedition from the United States under the leadership of Dr. R. A. Millikan, of the California Institute of Technology, Pasadena, mainly by the staff of Agra Observatory. This expedition made observations of cosmic rays at Agra, Gwalior, Peshawar and Bangalore, using large balloons to which were attached recording electroscopes and ion counters fitted with *radio sondes*.

New Instruments in Physics

An interesting account of the debt of modern physics to recent instruments comes from the Bell Telephone Laboratories in New York and is given by Karl K. Darrow (*Review of Scientific Instruments*, 12, 1–10; Jan.; 53–61, Feb. 1941). The instruments are classified into three types according as they are devoted primarily to observation, to measurement or to achieving new conditions. In the first article consideration is given to those instruments in which substances can be subjected to new combinations of physical forces or in which one variable is pushed to extreme limits. Bridgman's scheme for achieving pressures of the order of 100,000 atmospheres, Beams's ultracentrifuge rotating at more than 20,000 turns per second, the piezo-electric or magnetostriction oscillator, the Dickel and Clusius use of convection and thermal diffusion to separate isotopes, the attainment of vacua of the order of 10^{-8} or 10^{-9} mm. mercury, by the aid of oil diffusion pumps and 'getters', the attainment of temperatures of only a few hundredths of a degree absolute, and of high electric voltages, and magnetic field strengths are all dealt with. The second article is devoted to instruments of observation and instruments of measurement without enforcing too sharp a distinction to the two types. Both articles are well illustrated and give an excellent idea of the present limits reached in most branches of modern physics. The developments in that protean tool, the thermionic vacuum valve, and its resulting developments in acoustics are so great that another article would have been necessary to deal with them.

The Smithsonian Institution: Annual Report.

The report of the Smithsonian Institution for the year ending June 30, 1940, includes the report of the secretary, the financial report of the executive committee of the Board of Regents, together with reports on the United States National Museum, the National Gallery of Art, the National Collection of Fine Arts, the Freer Gallery of Art, the Bureau of American Entomology, the International Exchange Service, the

National Zoological Park, the Astrophysical Observatory and the Division of Radiation and Organisms. The last-named refers to further work on the problems of photosynthesis and factors affecting plant growth both from a nutritional and radiation point of view. Many measurements have been made of the rate of carbon dioxide uptake and the intensity of fluorescence during the induction period of photosynthesis, and respiration and chlorophyll studies have been continued with a recording spectrographic carbon dioxide apparatus. A standardized technique has been worked out for the extraction of plant growth substances from the oat seedling. Publication of the final revised values of all solar constant results from all observing stations from 1923 to the present time is expected during the coming year. Archæological excavations in south-east Mexico have been continued in co-operation with the National Geographic Society. Excavations at the Lindenmeier site in northern Colorado have afforded much additional evidence of the presence of Folsom man.

Publications handled by the International Exchange Service, which serves as the official agency in the United States for exchange with foreign countries of documents and scientific publications, considerably decreased during the year, as the exchange of publications was suspended between the United States and all European countries except Great Britain, Finland and the Soviet Republic. A list of foreign depositories of Government documents is included in the report. The work of the Astrophysical Observatory concerning the radiation of the sun has been continued, and Dr. C. G. Abbot has endeavoured to evaluate the separate influences produced on weather by long-range solar periodicities, and changes in phase of the weather responses have been found to be due to seasonal influences.

Recent Earthquakes recorded at Kew

During the week April 13–20, six large earthquakes were recorded at Kew Observatory. Three were on April 15, and there was one each on April 18, 19 and 20. The first on April 15 was very distant and the second was the important earthquake with epicentre near Colima (Mexico) (Nature, April 26, p. 507). This began recording with *iP* compressional on all three components at 19h. 22m. 19s. G.M.T. on April 15, and there followed a full suite of pulses, including *iS* on all three components at 19h. 32m. 39s. G.M.T., eL_Q on N and E at 19h. 46m. G.M.T., and eL_R on the vertical and E components at 19h. 50m. G.M.T. The earthquake finished recording at midnight on April 15, but what was probably the *iP* wave of an aftershock recorded on the vertical component seismograph at 19h. 58m. 25s. G.M.T. on April 15, superposed on the first. The maximum of the chief earthquake attained a ground amplitude of 880 μ at Kew. The shock on April 18 only gave rise to small amplitudes. The one on April 19 recorded *iP* dilatational on the Z component at 8h. 4m. 23s. G.M.T. and probably had its epicentre 7,220 km. away. The earthquake on April 20 attained an amplitude of 69 μ at Kew and was the second largest in the week. It began recording at 17h. 47m. 17s. G.M.T. with *iP* on the Z component probably from an epicentral distance of 5,440 km., and finished recording at 18h. 40m.

Earthquakes recorded in Switzerland

The Swiss Earthquake Bulletins from Zurich for November and December 1940 have just been received. Eight large earthquakes were recorded in November, and 10 in December. The earthquake of November 7, 1940, was recorded at all four observatories of Zurich, Chur, Basel and Neuchâtel and was felt with intensity IV at Gemeinde Muotatal, and at Schwyz with intensity III–IV. The earthquake of November 10 may have had its epicentre near Bucharest, and several aftershocks were also recorded. The shock of November 19 may have been near the Pacific Coast of northern Japan. On December 12 an earthquake, recorded at Chur, Zurich and Basel was felt with intensity IV in the region of the Mürtschenstock, Kt. Glarus, whilst the shock well recorded on December 22 at all four observatories, and in particular at Neuchâtel at 19h. 12m. 36·9s. G.M.T., probably had its epicentre in Central America.

Announcements

The title of reader in histology in the University of London has been conferred on Mr. Keith C. Richardson in respect of the post held by him at University College.

The Institute of Wireless Technology and the British Institution of Radio Engineers have fused, and in future the combined body will be known as "The British Institution of Radio Engineers Incorporated with the Institute of Wireless Technology". The president is Mr. S. A. Hurren, and Mr. G. D. Clifford has been appointed general secretary. The first annual general meeting of the combined body will be held in June, when the election of a council for 1941–42 will take place. All communications should be addressed to the Institution at Duke Street House, Duke Street, London, W.1.

A recent issue of the *Evening Standard* (London) quotes a British United Press message stating that traces of "a hitherto unknown prehistoric civilization have been found at Ipiutak on Point Hope, Alaska". It was already known that a very early and well-developed culture existed in Alaska, and the above message suggests new finds, confirmation of which will be awaited with interest.

There seems to be some misunderstanding concerning the leading article entitled "Relationship of Pure and Applied Biology" which was published in Nature of April 12, p. 427. As a leading article, the views expressed are, of course, those of the editors of Nature (formulated after considerable inquiry), and not those of a single individual. Neither is the article a summary of the discussion (to which reference is made) at a joint meeting of the Association of Applied Biologists and the Society for Experimental Biology. Summaries of discussions are published as such, and not as leading articles.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

A Possible New Approach to the Study of the Hydrogen Bond in Protein Structure

IN a recent review[1] Astbury has pointed out that the role of the hydrogen bond in protein structure, usually ascribed primarily to the keto-imino group, is largely unknown. Determination of the structure of such polar groups in the aqueous medium necessary for the normal functioning of the protein molecule is not easily achieved by means of the usual X-ray and infra-red methods. The monolayer technique has, however, proved of value in certain cases[2], and recent measurements upon simple compounds containing the –CO.NH– link indicate that cross hydrogen bonding between such groups does occur in water provided that the molecular spacing is suitable.

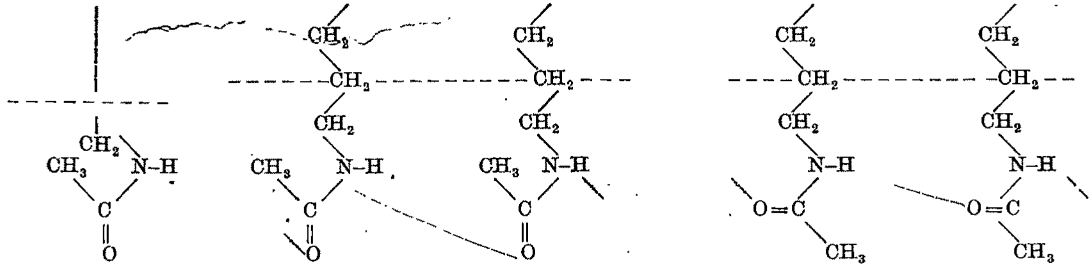
Condensed monolayers of acetamides and ureas were shown by Adam[3] to exist in two forms with a definite transition temperature, the latter being unusual in giving solid films even at an area of 26 A.^{2}. (Solid monolayers are usually only obtained with close-packed, vertical chains at 20–21 A.^{2}.) These and other facts are readily explicable by assuming cross hydrogen bonding between the molecules in the monolayer. A comparison between substituted amides and the corresponding esters which cannot form cross hydrogen bonds, for example, octadecyl acetamide and acetate, methyl stearamide and stearate, shows that the former tend to give very stable solid, and the latter much less stable fluid, films. The half-expansion temperatures ($T_1/_2$) given by Adam[4] are also much higher for the compounds for which cross hydrogen bonding in the monolayer is now postulated (amides, ureas, aldoximes and acids), and the tendency towards solidification is also very apparent (see accompanying table).

Calculation of the hydrogen bond distances in the various cases gives results in quite good agreement with known values; for example, acetamides 2·8 A. at 21 A.^{2}, ureas 3·2 A. at 26 A.^{2}, acids 2·8 A. at 24 A.^{2}.

The above principles are shown up most clearly by the acetamides which have now been studied in detail by both force-area and surface potential methods. The figure below shows the head-group configuration deduced for the expanded state and for the high- and low-temperature condensed forms.

Chain-length $C_{16}H_{33}$ in all cases.

Head-group ..	$-O.CO.CH_3$	$-COCH_3$	$-COOCH_3$	$-COOH$	$-CHNOH$	$-CONH_2$	-NHCON H
$T_1/_2$	20°	33°	34°	37·5°	42°	44°	48°
Nature of condensed film	Liq.	Liq.	Liq.	'Plastic solid'	Not known	Solid	Solid



EXPANDED FORM
$A > 47$ A.^{2}
$\mu = 302$ milli-Debyes
No cross hydrogen bonding.
Liquid film.

HIGH *T*. COND. FORM
A c. 24 A.^{2} (tilted chains)
μ c. 350 *m–D*.
Weak hydrogen bonding (bond distance *c*. 4 A.).
Liquid film.

LOW *T*. COND. FORM
$A = 21$ A.^{2} (vertical chains).
μ c. 390 *m–D*.
Strong hydrogen bonding (bond distance *c*. 2·8 A.).
Rigid solid film.

(Water surface undefined but parallel to the horizontal dotted line.)

In the acetates configurations almost identical with the first two are known[5], but there is nothing at all analogous to the third, where stabilization is obtained by cross hydrogen bonding. In addition to the hydrogen bond distances it is also possible to calculate, approximately, the free energy difference between the –CO.NH– group when forming hydrogen bonds with water (as in the expanded films), and when cross-linked (as in the low-temperature condensed form). The latter is found to be the more stable by about 800 cal./gm. mol.

The stabilizing action of the cross hydrogen bonds can be decreased, leading to liquefaction, by strongly acid substrates (for example, $5N.H_2SO_4$), as well as by increase of temperature. The effect of other reagents, such as urea, is being examined.

Similar considerations can be advanced to interpret the monolayer behaviour of the ureas, other amides, aldoximes, unsubstituted and α-amino acids, as well as mixed films, and will be given with further details in a forthcoming publication.

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April 5.

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Organic Bond Strengths and the Heat of Vaporization of Carbon

KINETIC studies on several independent chemical reactions have led to a value of about 104 kcal. for the heat X of removal of the first hydrogen from methane. Thus Trenner, Morikawa and H. S. Taylor[1] obtained 108 ± 5 kcal. from the reaction of deuterium atoms with methane, Patat[2] a value of about 103 kcal. from the *ortho-para* hydrogen conversion by methyl radicals, and Rice and Dooley[3] a value 100 ± 6 kcal. from the thermal decomposition of methane at high temperatures. Butler and Polanyi[4] have measured the velocity of the homogeneous thermal decomposition of alkyl iodides at low pressures, and their results, together with some thermo-chemical data, lead to the value $X = 103{\cdot}6$[5].

From this value and the known heats of reaction, $2CH_4 \rightarrow C_2H_6 + H_2$ and $H_2 \rightarrow 2H$, the C–C bond strength in ethane is 88·2[5]. (Rice and Johnstone[6] from the concentration, at various temperatures, of free radicals in ethane obtained a value of about 80 kcal.)

In his recent book "The Nature of the Chemical Bond"[7] Pauling has recommended an average bond strength for C–C of 58·6 kcal. It is the object of this letter to point out this serious discrepancy and to suggest an explanation; the variations in bond energies established by Rossini[8] are too small to account for it. Since Pauling's C–H bond strength (87·3) "is the value given by methane", that is, the average of the heats of the four successive hydrogenations of a carbon atom, a possible explanation is that the *first* C–H bond broken in methane is considerably stronger than the others. This would lead to too low a value for the C–C in ethane. Taking this first bond strength as 104 and assuming Pauling's average value, the average of the other three C–H bonds would be only 82 kcal. Two arguments oppose this interpretation: (1) Voge[9] has calculated the energies of these successive reactions approximately by quantum mechanics and obtained no such large differences. (2) The heat of successive substitution of the hydrogens in methane by a halogen varies but little along the series given by each halogen. Thus from the data for the heats of formation of the appropriate compounds given by Bichowsky and Rossini[10], these substitution heats are (for the processes $CH_4 + \text{Hal.} \rightarrow CH_3\text{Hal.} + H$, $CH_3\text{Hal.} + \text{Hal.} \rightarrow CH_2\text{Hal.}_2 + H$, . . . etc.): for substitution by Cl, − 21·1, − 21·4, − 21·1, − 20·7, by Br, − 35·0, − 32·5, − 32·0, − 31·0, by I, − 49·0, − 46·8, − 45·3 (fourth step unknown). It is difficult to see how such constancy for all three halogens is compatible with a large variation in the C–H bond strengths.

If, therefore, this hypothesis is excluded, Pauling's table of carbon bond strengths must embody some systematic error. The obvious possibility is uncertainty in the heat of formation V of carbon, as monatomic vapour, from carbon in the standard state (graphite or diamond). Two methods exist for the determination of V: (*a*) the spectroscopically observed dissociation energy of carbon monoxide can be related to it by known combustion heats; (*b*) by observation of the vapour pressure of graphite. Goldfinger and Jeunehomme[11] have considered that method (*a*) leaves three values possible: − 168·8, − 123·6, and − 107 kcal. They calculated the vapour pressures corresponding to each and compared these calculations with experiment. Their results show that the lowest value is very improbable, but, although the most modern and accurate determinations agree best with the highest of these three values, they adopt $V = -123{\cdot}6$, the value recommended from considerations of spectra by Herzberg[12]. As Herzberg pointed out, the vibrational levels are insufficiently known for a Birge-Sponer extrapolation, so that the evidence for V depends on the interpretation of certain predissociation limits and the assumption that these are not 'accidental'; moreover, Schmid and Gerö[13] have considered these data as supporting a value of V of only 73 kcal., which is on chemical grounds very unlikely. The spectroscopic results are not, therefore, unequivocal, while the high value 168·8 is supported by some calculations (of which the details were not given) by Penney[14], who obtained $V = 170$, "a value unlikely to be in error by more than 10%".

Now it can be shown that in these average bond strength systems, if V is too low by x, the C–H value will be too low by $\frac{1}{4}x$, the C–C by $\frac{1}{2}x$, and the C=C by x. If we take the high value 168·8 for V, Pauling's C–H of 87·3 becomes 98·6, his C–C of 58·6 becomes 81·2, and his C=C of 100 becomes 145. A similar correction to the 'average' bond strengths of Sidgwick[15], who took $V = 150$, gives for the aliphatic series C–H 98·4, C–C 81·1, C=C 143. These corrected values agree, to within the uncertainty inherent in 'average' bond strengths, with those derived from consideration of the decomposition kinetics of alkyl iodides[4,5].

The single assumption, therefore, that the heat of vaporization of graphite to monatomic carbon vapour is 168·8 or thereabouts is sufficient to reconcile the serious discrepancies between 'kinetic' and 'thermochemical' values for carbon bond strengths. In view of this fact, it would be of interest if further spectroscopic research could give a definitive answer to this question of the heat of dissociation of carbon monoxide.

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March 28

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Use of Silver Nitrate for the Histochemical Demonstration of Ascorbic Acid

SILVER nitrate in acid solution has been widely used for the study of the distribution of ascorbic acid in tissues and cells[1]. A survey has recently been made, using this method, of its occurrence in chick-embryos[2]. During this study a previously unreported phenomenon was observed in newly calcified bone: this was a heavy dark deposit which filled many of the newly formed trabeculæ of cartilage and membrane bone. The histological picture was similar to that produced in developing bones by the use of von Kossa's silver nitrate technique for the demonstration of calcium. A related phenomenon has been observed in the long bones of adult rats, which become bright yellow on treatment with acid silver nitrate. In specimens from both these types of bone prepared for histological examination there are seen dark deposits in many of the trabeculæ, quite different in character from the small black granules seen in other tissues treated by this method.

In view of the possibility that the atypical deposits seen might have been produced by the precipitation of a silver salt, followed by photo-decomposition of the salt during the preparation of sections, the following experiment was made. The femurs and frontal bones from twelve chick embryos of various ages were used. One frontal bone and one femur from each embryo was treated in the normal fashion and one frontal bone and one femur was placed in 5 per cent ammonia for 10–15 minutes after fixation in acid silver nitrate and washing in water. Fixation, washing and treatment with ammonia were carried out in brown bottles in each instance. In all instances in which acid silver nitrate produced discoloration of the bone, subsequent treatment with ammonia restored the normal appearance, and atypical deposits were absent in histological preparations. Similar results were obtained with rat bone. Treatment of rat adrenals with ammonia after fixation in acid silver nitrate had no effect on the histological picture.

These results indicate that in some tissues the histological picture produced by the reduction of silver nitrate in acid solution by ascorbic acid may be complicated by a process which is probably due to the precipitation of silver salts followed by photo-decomposition; this complication can be obviated by treatment of the specimen with 5 per cent ammonia. It is suggested that this treatment with ammonia after fixation in acid silver nitrate constitutes an improvement in the technique for the histochemical demonstration of ascorbic acid, in that it increases its specificity.

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Dependence of the Direction of Rectification in Copper Pyrites on Voltage, Temperature and Time of Measurement

The reversal of rectification by heat in molybdenite[1] led to the study of the rectifying properties of copper – copper pyrites contacts. In most cases, it has been found that below 1 steady volt the normal direction of easy flow is from the metal, but it reversed between 20° and 200° C. For voltages of the order of several volts, the conductive direction is from the crystal, but it reversed between 20° and – 78° C. The relation between the transition voltage and the transition temperature indicates that above a critical temperature of about 500° K., or above a critical P.D. in the neighbourhood of 20 volts extrapolated at the absolute zero, the direction of rectification is always the same. A similar phenomenon occurs in thermocouples when the cold junction is above the neutral point, or when the temperature difference between the two junctions exceeds twice the neutral temperature.

On changing from D.C. to A.C., it is occasionally observed that the direction of the rectified current is opposite to the direction of the larger current. This is explained by a time lag in the current, arising from the contribution of some integrative action related to the direction of the applied voltage.

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Sense of Hearing in Fishes

In his review of our knowledge of the sense of hearing in fishes, von Frisch[1] only quotes one observation in the field, and in his summary says, "spontaneous reactions to musical tones are not to be expected, since the sound signals used by us have no biological significance for fishes. Reliable reactions can therefore only be obtained by conditioning to tones."

It may therefore be of interest to put on record an observation that I made some years ago in British Guiana on the response of fishes to sound under natural conditions. I was at the time visiting at frequent intervals Plantation Ogle, a sugar estate in the low-lying coastal area south-east of Georgetown. The estates are drained by a number of shallow canals along which the sugar-cane is towed in barges to the factories, and there are many low humpbacked bridges over these canals.

I find in my note-book the following, dated September 16, 1916. "In crossing a bridge over one of the trenches I noticed that numerous small fish were surface feeding in small groups in the water, but at an accidental noise they all dived deep. I tried waving my arms suddenly without noise but this had no effect. Clapping my hands or ringing my bicycle bell, on the other hand, caused them to dive so suddenly that the whole surface of the water was disturbed." I repeated the observations on several days and distinctly remember one experiment in which I laid my cycle on the ground and crouched low so that I could only just see the surface of the water. When I rang the bicycle bell, the only movement being that of my thumb which was in any event quite out of sight of the fishes, the response was immediate and striking.

There is no doubt in my mind that these fishes heard and reacted to a sound which, according to von Frisch, should have "no biological significance" to them; but what natural warning sound, if any, it simulated I am unable to suggest.

Perhaps some resident of British Guiana could repeat my experiment and get some of the fish identified.

I may add that I have recently tried the effect of a bicycle bell on goldfish in a pond here at Rothamsted but cannot see that the fish respond in any way.

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The Cleavage in Biology

THE leading article on the "Relationship of Pure and Applied Biology" (NATURE, 147, 427; 1941) paints a lamentable picture of the separation of pure and applied biology, lamentable because, as it claims, each is needed to fertilize the other. The article explains how in the universities research has become an end in itself and purity its ideal. It implies also that in research stations utility often provides an opposite and exclusive ideal. Each of the two ideals justifies its own kind of enthusiasm for research and persuades us of the reality of the opposition between them. Nothing but good can come of showing that the opposition is unnecessary; that snobbery and counter-snobbery are equally artificial, and that pure research can develop as it should develop only if it is continually harassed by the demands of necessity. It is the absence of necessity or apparent use that in past times has often led science, or some parts of it, into backwaters where the inevitable weeds of scholasticism have clogged its stagnant channels.

All this is clear enough; but it is not the root of the matter. There is, as the article says, underlying the cleavage of ideals a cleavage of organization and material resources. With a few important exceptions there is a division in biological research between those who have to teach in the universities and are free to follow pure research in their spare time, and those again who work in research institutes of medicine or agriculture and who to a greater or less extent are expected to achieve practical results. Each party develops its own comfortable philosophy, comfortable at least in a stable environment. *Il n'est point de sot métier.*

The separation of teaching from applied research does harm to the research. New recruits to research from the universities have to unlearn a great deal of what they have learnt and, having in this way lost their simple faith, stand a poor chance of being allowed to teach again. But consider the harm it does to the teaching. A professor of botany told me recently that it was no use trying to develop the teaching of botany into something more useful since botany was only taught to people who would teach botany to people—and so on for ever. This is the principle of the 'fundamental training' seen from the other side of the hedge. Is it any wonder that the standard university text-books scarcely mention any of the uses that can be made of a knowledge of plants and animals? And that they confine their statements about genetics and cytology, for example, to a reiteration of formulæ which have obviously meant as little to the men who write them as they will to the men who read them?

Surely then the remedy is not, as the article proposes, an interchange of personnel between institutions which continue to pursue divergent paths of pure and applied research. Such a policy would touch only the surface. No, the union of interests must be complete. The divergence must be suppressed; and it must be suppressed by the fusion of pure and applied research, by the fusion of both with teaching.

A radical reconstruction is therefore needed in the relations of teaching and research, of universities and stations. Let no one object that fearful obstacles lie in the way. Of course they do. Thirty years will be needed to accomplish the change. But accomplished it will be.

Once an organic union of the two parties is established the rest will follow. Syllabuses will be revised, the necessary 'fundamental training' will become much more fundamental and much more of a training. The sterile separation of botany and zoology will become a fruitful union. The combination of small departments will bring them to a size suitable to the work in hand. The importance of chemistry and statistics and even downright craftsmanship will be admitted and exploited; and, by accident or design, the impossible hope of NATURE will have been realized—a training in biology will have become an education in itself.

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April 18.

As Dr. Darlington points out, the divergence between pure and applied biology must be suppressed "by the fusion of pure and applied research, by the fusion of both with teaching". Thirty years, indeed, will be needed for this, if not much longer. To effect this remedy immediately is, of course, impossible; then surely the suggested interchange of personnel should be the immediate aim with complete fusion as the ultimate aim.—Editors of "NATURE".

"The Man of Science as Aristocrat"

IT is indeed a privilege that in NATURE we can enjoy an article by Mr. H. G. Wells. I, like him, would like to preface the remarks I have to make upon his contribution by paying my modest tribute to NATURE. I know nothing more wholesome than a perusal of the "Letters", at least 50 per cent of which must be pure gibberish to most people, but absorbing to the few interested in their particular subject raised. Humility of mind over such abysmal ignorance of so many subjects is a fine correction in these days of the 'cock-sure'.

H. G. Wells obviously comes under the head of a man of 'general intelligence'. I make no such claim. I get included by virtue of "a broad curiosity outside the ranks of the specialist worker".

In a debate on Mr. Wells's recent lectures in the United States and why he was allowed to go and air such curious views Mr. Peake, speaking for the Government, put up an admirable defence of his conduct on the ground that we all knew Mr. Wells and that we must look upon him as one of our "invisible exports". I have never quite decided whether Mr. Peake meant very subtly that we can all see through Mr. Wells or not, for although he derides the patent laws and condemns them—"we must all work for the common good"—, I see no urgent advocacy of the abolition of copyright. The miserable capitalist world that recognized Mr. Wells's genius has by its machinery not only kept him from starvation and being 'bumped off', but also made him incidentally one of the most privileged of the privileged classes.

Success in literature has been his, with its reward. If he had levied toll on the world for his invention of the cinematograph, would the "arrogance and detestableness of his nature" have been brought out? Certainly not. It was not brought out by his success in literature for the reason it was not there. A more lovable, maddening man I have never met.

Mr. Wells makes a plea for the man of science to look upon himself as an aristocrat. This, indeed, must make Robespierre turn in his grave, and surely in some States must put some of our friends in danger. To jump from the proletariat, ignoring the *bourgeoisie*, to be an aristocrat, would certainly endanger, I should imagine, Prof. Kapitza's life. Dangerous advice from a socialist; but we get his meaning. I do not think his tongue was in his cheek when he wrote that, but, when Mr. Wells writes, the position of his tongue is important, which goes to show the superiority of the spoken over the written word.

My point is, why should the man of science look upon himself as an aristocrat? Granted, he may be doing work which will be of use to the world and not to himself; a soldier also does that. A man of science works at the subject he adorns because that is his bent in life and where he can best satisfy himself. It does not follow—brutal as it sounds, it must be made clear—that because a man of science is brilliant in his sphere he can take on any job and shine at it. A man can be a brilliant man of science but unable to make his way in life in any other direction. Even Sir Isaac Newton never shone as a member of Parliament. A well-known fellow of the Royal Society complained to me the other day that working as he did in a particular Ministry he was valued for pay on the basis of a major, and I am brutal enough to think that that is about right, once a specialist gets out of his groove.

I agree that the man of science and the specialist working in his groove have produced in our time the motor-car, the aeroplane and the radio, which by the 'wisdom' of man have been turned into the Panzer Division, the night bomber and lying propaganda. All this is indeed desperate, but it does show that technical minds outstrip political wisdom and that it is easier to discover X-rays than to placate Europe.

The sort of article Mr. Wells has given us tends to get all values wrong. Technical research may benefit the world or not, that depends on how it is ultimately used; but for the advancement of the general happiness of mankind concentration by the brains of the country is required on government and planning. That is the most difficult and important of all science. I suppose Mr. Wells would class it as politics and fire squibs at it; but because it is neglected and despised, because there are no chairs and no places for its students in the Royal Society, the most difficult of all subjects is being neglected as science.

Let us get our values right. The man who by his political efforts can get adequate milk to children deserves more of his fellow men than the inventor of the quantum theory; but in the narrow world of science, who gets the most attention and encouragement?

Aristocracy means government by the best. If the man of science means to come out of his shell and help us in the problems and perplexities of life, good luck to him. What we can do without, however, is the specialist, usually with the pen, divorced from all the responsibilities of public life but laying down high priestly criticisms of all and sundry, as if knowledge, foresight and wisdom lay with him alone.

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April 25.

ACCORDING to Mr. H. G. Wells, it would appear that inventors and research workers must be stoically and aristocratically resigned to even worse conditions under democracy than they have hitherto endured under pluto-aristocracy.

But, surely, if democracy abolishes the rich patron, it must be prepared to wear his mantle and do his job.

The precedent is already to hand, for example, in the Civil List, from which State payments—pensions or gratuities—are already made to deserving individuals. It would, of course, be necessary to organize an extensive machinery for administering State patronage—as of right—to all deserving cases; but the advantage to the cause of national progress might be very great. Inventors, research workers, artists and the like would at last be protected from the "Smart Alecs"—they would be rewarded by the State in proportion to the benefits they had rendered to the community.

As to the scale of payments—a progressive manufacturing firm may spend from 1 per cent up to 2 or 3 per cent of its annual turnover on research and development; a wise and progressive democracy might well do the same, and spend as much on research and development as we have hitherto done on national defence.

The same organization might, with great advantage, have the duty of recommending the bestowal of national honours for public services rendered.

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'Pancake' Ice in the Pennines

ON February 2 during a severe frost a visit was made to High Force in Upper Teesdale. The Force was a spectacular and beautiful sight, with a considerable cascade of water descending between great curtains of ice, and heavy icicles draping all the surrounding cliffs formed by the Whin Sill. But it was the pool below the fall itself that invited special attention and comment. Here on the agitated surface were floating rounded pieces of ice, formed apparently at the height of the frost on the pool-surface, which later became disintegrated. Some fragments, however, may have been derived from the surrounding walls, or have descended by the cascade from the upper reaches of the river. Mr. Bentley Beetham, of Barnard Castle, who accompanied me and who has before seen the Force under frozen conditions, favours the first-mentioned alternative for the origin of the ice-glaçons.

It was noticed, moreover—and this is the main point of interest—that the glaçons were not merely rounded, presumably by attrition in the agitated water, but also had their borders sharply raised in the manner of 'pancake' ice of the polar seas. The 'pancakes' were up to about one foot in diameter, and would seem to have been formed under such conditions of temperature and movement—in order to provide the correct plasticity and shape respectively—as are to be found in the well-known examples in the arctic and antarctic seas. The latter have been strikingly illustrated in Wright and Priestley's "Glaciology" of the Scott Antarctic Expedition, 1909.

It is not known that pancake ice has been described from other than polar regions.

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TOWARDS A NEW GEOGRAPHY

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WHATEVER shapely forms the new world of reconstruction will take no one is certain as yet. It will be well if we stand firm in the belief that what we must start from is not some blue print or paper scheme, but from where we are now. The way the nation thinks must be determined, to a large degree, by the way it is taught. An overhaul of our educational system, an examination of the validity of the principles and facts inculcated into the minds of young people, might be a valuable contribution by educationists to the new order democracy hopes to build.

It is with this idea in mind that this article takes up the question of geography as a subject learned and taught. Greek interest in the *oikumene* started off a long lineage of environmental study from Strabo to Bodin, Buckle, Ritter, Herbertson, Geddes and many others. The duality of the environmental concept-man and Nature has been constantly attracting philosophy and science. We are now some distance from Montesquieu, who explained the virtues of the English constitution by the vices of its climate; but determinism will out, and mole hills of causality become mountains of effect. Convention ties the geographers to the bed rock of physical elements, and their human geography is still too much a product of the soil.

In a chapter on the geographical factor in his "National Character", Prof. Ernest Barker, quoting in some degree from the work of Edouard Meyer, has shown some of the fallacies of determinism. It is man, he says, who arouses the dormant energy of natural resources and makes them geographical elements. Coal and iron had been in our soil for millennia before man used them and made them factors in our economic situation. Again, the sea was at our gate for countless ages before we became a maritime nation. Prof. Toynbee in his recent work gives full play to environmental forces in tracing the history of civilizations, and he finds psychological factors as potent as physical, and spiritual vitality as determinant as climate and soil. Febvre again goes so far as to say that it is human activity, not soil and situation, which governs the game. There is no 'law of islands' imposed on human society, only variety and difference. Michelet could say of Flanders, "it has been created so to speak in defiance of Nature. It is a product of human labour". All of which seems to imply that man is a geographical agent, and that if history, as Prof. Rait says, is largely what geography makes it, geography is no less the product of history. The environment of to-day is the sum of all our yesterdays.

It is true that our geographers of to-day allow more room to human initiative and will than of old, but they have a speciality to conserve, and they make strange claims for it. Now it is merely 'a point of view', now 'a synthesis'. As a way of looking at world phenomena the geographical aspect is possibly a necessity in particular cases, but that scarcely makes it a subject. The claim to be a synthetic study results from the method. If you collate data from all and sundry sources you must synthesize or suffer mental indigestion. The trouble is that in fact the geographer has to select what is digestible, but a partial synthesis is not scientific. This may be illustrated by reference to that excellent little classic on "Modern Geography" by the late Dr. Marion Newbigin. It presents a sequence of the varied content of conventional geography. There are the physical aspects of natural landscape, the biogeography of plant and animal life, and the relations of these with human society and its activities. It presents a rational picture of man and Nature; but what concerns us now is that the relationships which in the synthetic view should be cardinal, are but fractional. The elements exist in themselves, and they get on very well without being related. Synthesis in fact is a deliberate and consciously applied process, not one which operates in virtue of the coincidence of distributions.

Again, we may say that the physical map is the foundation of regional analysis, that certain results follow from given terrestrial forms; but there is nothing inevitable in any particular set of circumstances, and differences in effect may be more striking and significant than identities. The result of generalizing as to relations from specific examples is analogous to seeing the wood without perceiving the trees. Climate and vegetation regions there may be; but the real interest and importance often lies in the differences in superficially identical distributions. Grasslands may look all alike on the vegetation map, but they are not so in reality. The transformation of the Argentine pampas by artificially sown grasses is not represented on most maps in current usage.

Geographers seem to spend an inordinate amount of time in the classification of phenomena, and the atomization of regions in particular seems to have reached to ridiculous lengths. The 'natural region', once so fundamental as the epitome of physical and human interactions, has become a wanton unloved by the many, though most are loath to abandon it. It would have been better perhaps to leave it in its original literal sense as a Nature-made region as distinct from the cultural region which bears the impress of human activity. At any rate, hunting down regions as an end in itself has gone far enough. At best they are just frameworks, and what really matters is what is built into them.

A word may be said here about what might be termed 'map idolatry'. The map has been the sheet anchor of the geographer. There is a curious belief that it is a basic element, and that everything begins and ends in a map. Now maps are often as beautiful as they are useful, but even the best of them is merely a symbolic representation of selected facts. They are built up of layered distributions which are necessarily incomplete. A map leaves out much more than it can ever contain, and a great deal has to be read into it before it can mean very much. In short it is an auxiliary, not a fundamental element. It is a mistake to suppose we can base a serious study on empirical documents. A map is to the geographer what the time-chart is to the historian, merely a convenient method of setting out a proportion of the facts, not an original source material, for it is already a synthesis.

If the geographer still clings to deterministic frameworks, it may be claimed that he has escaped from causality. It is true that a rather vague 'possibilism' of Gallic origin has been substituted—influences replace conditions. So far the change in emphasis has not produced any great revolution, and text-books and the man-in-the-street still argue causally on environment. Yet the dominance of man as a geographical agent is obvious. His intelligence, if not always his wisdom, is at work, and he has altered the face of Nature so much that a cultural has replaced the Nature-given pattern. Examples are abundant. Railway and road construction, airways and shipping lanes, irrigation, the transplanting of crops and resources, plant genetics, and so forth. The rape of the earth may be only one side of the story ; but at least it is evidence of human energy and activity.

What emerges is that the whole traditional approach to geographical questions needs revision, in that conventional geography still assumes man as an effect and not as a cause. Since palæolithic times man has never left the terrestrial scene, and both Nature and man are dynamic forces, and in a general sense man has been historically the dominant partner.

Any human group and any area may be said to be affected by two elements. One is made up of the internal and local influences operating by direct contact, and the other comprises all those external agencies which may be local or world wide, and which may or may not be more potent than those native to a given group or area. In contemporary society the 'home geography' is more and more a reflection of wider impacts which are breaking down isolation and modifying local characteristics. This species of universal leavening is, of course, a slow process, no doubt desirably so, and the universal pattern is much less well defined than local regional features at the moment. Yet this, too, carries with it the implication that human forces and actions have wrought and are still working transformations which demand a new approach to geographic studies. If, as has been implied, man throughout history has modified the natural landscape and given it ever-changing influences, it follows that the geography of the past, apart from physical changes, must be largely the record of his activities. Here is the true historical-geography, and most of that has yet to be written. This evolutionary aspect of environment, changing in substance and in incidence, is a matter of history, a 'natural history', with its central theme the place of man, creative man, in the development of the natural world.

"Geography is about maps, history is about chaps", so the schoolboy is reported. Discussions about the relations of history and geography, the meaning of historical-geography, and so on, have been held frequently, but as yet the bridge between the two subjects is still to seek. The study of a border-line marginal area necessarily makes difficult the fixing of limits. Framed as is our academic practice within a group of 'subjects', there seems no place for the historian-geographer or the geographical-historian. He should be obviously a free agent, free to draw on historical and geographical matter with whatever emphasis truth seems to require. He should not have to argue the historical factor in geography or the geographical factor in history according as to whether he is in the historical or the geographical camp. In practice he has to live and must perforce line up with one or other of the recognized 'subjects'. The divorce of man and the *oikumene* as subjects of study has resulted in the cleavage we now see. The pre-historians and the archæologists at the moment seem to be most successful in the handling of the dual theme. Too much of what passes as historical-geography suffers by the separation of bones and flesh. The historian is too often content with an introductory chapter and ignores the fact that his 'stage' is there all the time, and the scenes change, while the geographer it might be said is too interested in the decking and stage 'props' to notice much difference in the actors. There is an aridity which results from the isolation of physical and material factors as subjects of study apart from their human setting. It is man who gives them the stature that they have.

The major function of geographical study is to delineate the features of the contemporary world, and while the present has its roots in a past, and is not intelligible without some reference to that past, there is a justifying substance in contemporaneity. Things happen somewhere now as well as then. When the servant girl in Mr. Coward's play asks "Where is Africa ?" her query expresses very well our general attitude to strange places. For most people acquaintance with the world about us is embodied in a cartographical outline dimly recollected from schooldays, with some detail here and there perchance remembered, but no catholic knowledge of the living societies, modes of activity and organization which function inside the framework. Geography in general education covers that area of knowledge which is concerned with international questions, political and economic features, trade and communications, and the exploitation of resources. An understanding of the nature of an integrated world order, a society of elements separate and self-contained but forced into contacts and relationships —this seems an obvious need. The older latitudinarian treatment of political and economic geography might well be revived to offset our current practice of putting everything into the regional pot. Here again the difficulty is in determining what is specifically geographical and what is not, and the question arises also as to the desirability of separating out an aspect which may only have significance in its relation to more directive and active forces. What is wanted both in the regional analysis and in the broader studies on a world basis is, so to speak, less anatomy and more physiology, less of structures and more of functions. The world is a going concern and its mechanism is in motion, while we tend to regard it as if it were at rest.

'Human geography' was a term introduced to describe all the geographical elements which were not Nature-given. It admitted man as a factor in the equation, rather grudgingly perhaps. It is a long jump from this to the latest school of geographical philosophy, that of geopolitics. Swedish in origin, this geopolitical school has found its home in Nazi Germany. It thinks of blood and soil as destiny, and its main tenet is that State, race, and land must be regarded as an organic whole, as a metaphysical entity in which the citizens exist only in and for it, while at the same time it is more than the sum of the nationals who compose it. This spurious pseudo-science is in the Ratzel tradition, and we are right back at determinism again. It is the concept of *Lebensraum* which justifies the essential geographical basis of this ideology, for terrestrial expansion of living space is a concomitant of it. The best that can be said of this warped and distorted philosophy is that man is given a more potent if not a higher place than in some other terrestrial philosophies.

The recent revival of mechanical conceptions of society are perhaps a reflexion of the instability and lack of conscious political purpose of a world society in which economic factors and modes of physical contact are establishing a new segregation of population, and in which time-distance has so largely replaced linear distance.

If there is any validity in these reflections on the present condition of geographical study, it becomes evident that some changes in principles and methods are called for. The restoration of man and his mind to their proper sphere as purposive and active elements rather than passive agents, is beginning to appear in some kindred sciences such as physics and biology. Dr. Isaiah Bowman has written of the "timeless creative experiments" which man is participating in, and geography as one of many forces which are involved in it. Man appears in the world but is not altogether of it. As a tool-using animal he gave expression to powers and forces not hitherto known to Nature, and if he remains still part of Nature he carries some evidences of spiritual resources which Nature may utilize, but she cannot endow him with them. Let the argument start from the spiritual ancestry of man rather than from his animal origins, put human will and aspiration and effort first, and the terrestrial domain second—it is after all underneath our feet if we stand up—and the old premises which have clamped us down so long must vanish, and maybe a new birth will be given to a most ancient part of knowledge.

MARINE ANIMAL OILS OF CANADA

By Prof. T. P. Hilditch
University of Liverpool

THE varied and abundant fauna of the rivers of Canada and especially of the Atlantic and Pacific Oceans on the eastern and western shores of the Dominion form an important section of its natural resources. Canadian salmon, pilchard and cod are well-established edible commodities, but it is perhaps less widely known that in recent years the Canadian production of fatty oils from the flesh, livers, or other specific parts of certain fish and marine mammals has greatly expanded, whilst the quality of the oils is generally of a high standard owing to the increasing use of plant and conditions of extraction in accordance with the results of modern research on the chemical and technical properties of marine animal oils.

Up to the present the fish oils which have been most largely produced in Canada are from pilchards, herring, salmon, cod and halibut. Pilchard and salmon oils are extracted in quantity on the Canadian Pacific coasts, herring oil mainly on the Pacific, but also on the Atlantic shores, whilst halibut is taken from both oceans, and cod mainly but not entirely from the Atlantic side. The total annual fish-oil production of British Columbia varies from 2·5 to 4 million gallons per year, of which pilchard oil usually provides 1·5–2·5 million gallons; the Canadian annual production of cod liver oil of all grades is usually more than 150,000 gallons, although this is only 25–35 per cent of the amount of this oil produced in Newfoundland. There are, however, oils from a large number of other species of fish—coalfish, rockfish, rays, grayfish, ratfish and others as well as the more familiar ling, hake, mackerel or haddock—from which fatty oils could be produced in quantity. Again, more than 500,000 gallons of whale oil are made annually from whales taken off British Columbia; nearly half this output is from sperm or toothed whales, the rest from the baleen whales; seal oil is obtained in less amount (50,000–70,000 gallons per year) on the Atlantic coasts, and porpoise and dolphin oils, although not in much demand, could be obtained in quantity since these members of the Delphinidæ are plentiful off all the coasts of Canada.

Marine animal oils differ to quite a large extent in composition, although there are fundamental similarities in the kinds of fatty acids present in the form of glycerides or wax esters. Those of the cod or halibut liver, herring, salmon or baleen whale flesh, and many others are all comparatively similar, especially in containing major proportions of glycerides of highly unsaturated fatty acids with 20 or 22 carbon atoms in the molecule; but even in this group there are well-marked differences in the general proportions of the component fatty acids which seem to be mainly determined by species—perhaps also by dietary and other factors. Some of the other oils which have been mentioned differ more radically in chemical composition. Those of the sperm whales are largely wax esters and not esters of glycerol, the alcohols in combination with the mixture of fatty acids being largely cetyl, $C_{16}H_{33}(OH)$, and oleyl, $C_{18}H_{35}(OH)$. Ratfish liver oil seems to consist to a very large extent, not of glycerides, but of fatty acid esters of complex ethers of glycerol with a higher fatty alcohol. The Delphinidæ oils contain large amounts of *iso*-valeric acid in conjunction with the more usual kind of higher fatty acids, in the form of mixed triglycerides. It is natural that such variation in composition should afford scope for a variety of technical uses.

Probably, however, the most interesting of the fish oils at present are those which are found to be exceptionally rich in the fat-soluble vitamins. Halibut liver oil and, still more, the visceral oil, are well known in this connexion, but this is by no means the only instance. The production of exceptionally vitamin-rich fish oils, which serve as a valuable source of vitamin-A concentrates for incorporation in edible fats, is one of the most important fish-oil industries to-day. Although unsuitable *per se* for margarine or soap manufacture (by reason of odour and of proneness to atmospheric oxidation), fish oils and, more particularly, baleen whale oils, are converted by hydrogenation into more stable fats of high quality. But a number of other uses have been found for these oils, some of which may be less familiar. In contrast to their nutritional values, fish oils and their soaps find considerable use as toxic agents in insecticides, especially in fruit growing; the applications of these oils in the leather and textile industries are probably better known than the growing use of hydrogenated fish oils in the manufacture of tinplate; they can be transformed into rubber substitutes as well as into varnishes or linoleum.

The wide range of utility of the marine animal oils, potential as well as actual, is extremely thoroughly covered in a recent Bulletin edited by Dr. Brocklesby*; but the work can be commended for other reasons which will appeal to readers of NATURE. Instead of being limited to the purely technical aspects, the discussion of the latter is based entirely upon the fundamental chemical and physical properties of the fats, which are dealt with so adequately that the book forms a remarkably complete guide to the chemistry of fats as a whole. Moreover, the component acids and glycerides of the marine animal oils are considered in the light of modern research in this field (to which the chemists of the Pacific Fisheries Experimental Station have made their own contributions) and not solely with reference to the technically useful, but otherwise often uninformative, 'analytical characteristics' such as iodine values, specific gravities, etc.

The late Sir William Hardy, first director of Food Investigation of the Department of Scientific and Industrial Research, planned that the work in his research stations should involve equally the technical applications of science and the fundamental principles underlying these applications—a tradition which is still followed by the Food Investigation Board. It is evident that the balance between 'pure' and 'applied' science is similarly maintained by the Canadian Fisheries Research Board; in consequence the monograph now published will be read with as much interest and benefit by other scientific workers as by the technologists for whom it is primarily intended.

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* The Chemistry and Technology of Marine Animal Oils with particular reference to those of Canada. Bulletin 59 of the Fisheries Research Board of Canada. Edited by Dr. H. N. Brocklesby (Chief Chemist, Pacific Fisheries Experimental Station, B.C.). Pp. 442+74 figures. (Ottawa: Fisheries Research Board of Canada, 1941.) 2.95 dollars (paper), 3.80 (cloth) net.

ELECTRIC HEATING OF BEEHIVES

THE British Electrical and Allied Industries Research Association has issued a preliminary report, by its director and secretary, Mr. E. B. Wedmore, describing experiments on the heating of beehives*. It also describes the construction and preliminary testing of certain units for keeping beehives at any required temperature. Tests are to be made shortly at the Rothamsted Experimental Station under working conditions on a large scale.

In Nature, the heat required by a colony of bees is produced by the consumption of honey. This is an expensive fuel, and might be helped out and controlled to advantage by the use of electricity. Many observations of temperatures within the hive in relation to the life and requirements of the bee have been made, and the craft has turned in the direction of controlled heating of hives. The aim of the present report is to bring the problem into perspective and to record some preliminary observations on effects within the hive of changing external temperatures and conditions, and of the use of certain heating units.

In obtaining figures of convenient magnitude, and in considering electric heating, it is convenient to measure all energy in electrical terms. The complete combustion of 1 lb. of an average honey with an average water content represents two watts for one month, and honey in the hive may be taken as being worth 6*d*. per lb. (If removed, extracted, strained, bottled, packed and carted, it may be worth, say, 1*s*. 4*d*. wholesale.) Thus the production of heat by the complete combustion of honey costs 3*d*. per watt per month if the efficiency is 100 per cent. The heat is, in fact, produced by the bees deliberately performing mechanical work, and while the oxygenation is probably fairly complete, there is wear and tear to be made good as well as shortening of the bees' life, so that the actual cost per watt per month to the beekeeper must be higher, but most probably less than twice 3*d*.

If sugar is used, the heat of combustion is about doubled, but if reduced to syrup by adding water, this additional water content has to be dealt with. The physiological loss is greater and the syrup has to be prepared. Taking the sugar syrup at 6*d*. per lb. of sugar including labour and wastage in storing, the cost per watt per month will be between 1½*d*. and 3*d*., not allowing for maintenance of and interest on the cost of apparatus.

Electrical energy could be substituted for honey consumption only if the heat be provided at the right time, the right place and in the right quantity. Assuming 100 per cent efficiency in each case, we have then for the cost of 1 watt per month: (*a*) by consumption of honey in the hive at 6*d*. per lb., 3*d*.: (*b*) by consumption of sugar in the hive at 4*d*. per per lb., 1½*d*.; (*c*) by use of electrical energy at 1*d*. per unit, ¾*d*. It is clear, therefore, that there must be some definite additional indirect gain if heating by electricity is to be justified, the cost of the equipment must be low and the technique of its use simple and efficient.

With the commencement of frosts in October, breeding is greatly reduced, and it ceases in December or earlier. Bardenbacher's tests suggest that brood raising may be advanced about three weeks by appropriate heating in the spring season, and one such advanced colony may well do the work of two. It is pointed out that in spring there are good hopes of stimulating brood raising by making it easier for the bees to maintain the requisite temperature, especially at night and in cold periods, and at the same time reduce the indirect losses caused by condensation of moisture.

Data as to the thermal properties of a hive and its contents are given. The hives are usually constructed of cedar or firs of varying quality, and some are painted. Probably reduction of forced movement of air within the hive in really cold weather by guarding the entrance is more important than any external packing.

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* British Electrical and Allied Industries Research Association Technical Report, Reference W/T5: Electric Heating of Beehives—Preliminary Report. By E. B. Wedmore. Pp. 19+5 plates. (London: British Electrical and Allied Industries Research Association, 1941.) 3*s*. 6*d*.

To obtain currents of 1–20 watts from a 230-volt circuit requires resistances which, if wire-wound and suitably insulated, are relatively costly. On the other hand, two miniature lamps of suitable rating in series will give results of the right order at a moderate cost with reasonable life, and will admit of wiring a number of hives in parallel off a mained loop from hive to hive.

The hive used for preliminary experimental work consisted of a standard National body on a base with deep cover, a 6-in. lift being used to carry the heating units and packing so that the deep cover just overlapped the top of the body box. The hive was located in a well-ventilated wooden shed to protect it from winds. In certain tests a small fan was used to blow a stream of air at a speed of about 12 m.p.h. diagonally at the entrance. The hive used represents roughly the minimum size of stock hive that would be employed for wintering in Great Britain.

It has been shown that a small increase in the difference between the internal and external temperatures of the hive has a useful effect in reducing condensation and consequent dampness. Two periods have to be considered, namely, the quiescent period and the early brood-raising period. The useful applications already made belong to the early brood-raising period; the difficulties met with are mainly difficulties of control.

Twenty-four heating units are being built for Rothamsted Experimental Station, where they will be used with and without thermostatic control during next winter.

FORTHCOMING EVENTS

Monday, May 5

Royal Society of Arts (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Dr. G. Stafford Whitby: "Chemotherapy", II.

British Psychological Society (at 55 Russell Square, London, W.C.1), at 1.20 p.m.—Mrs. Winifred Raphael: "War-Time Grouses in Industry".

Thursday, May 8

Institution of Electrical Engineers (at Savoy Place, London, W.C.2), at 2.30 p.m.—Prof. S. Chapman, F.R.S.: "Electrical Works by Helios, or The Sun and the Ionosphere".

Friday, May 9

Geologists' Association (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. C. E. N. Bromehead: "The Early History of Mining".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Teacher of Engineering Workshop Practice and/or Woodwork and Drawing, and a Teacher of Mathematics and Science, at the Mexborough Schofield Technical Institute—The Secretary to the Managers, Education Office, Mexborough, Yorks. (May 10).

Senior Assistant Master to teach Science and Mathematics at the Sparkhill Commercial School—The Chief Education Officer, Higher Education Department, Education Offices, Council House, Margaret Street, Birmingham 3 (May 12).

Principal of the Shrewsbury Technical College—The Secretary, for Education, County Buildings, Shrewsbury (May 21).

Professor of Mechanical Engineering—The Registrar, University of Sydney, Sydney, N.W.S., Australia (June 1).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. War Food Production Advisory Bulletin No. 2: Ley-Farming. By Sir R. George Stapledon. Pp. 22. (Aberystwyth: Welsh Plant Breeding Station.) 1*s*. [313

Spectrochemical Abstracts. Vol. 2, 1938–1939. By Ernest H. S. van Someren. Pp. 38. (London: Adam Hilger, Ltd.) [313

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 37: Studies in Peat, Part 10: Activated Charcoals from Peat Residue. By Dr. Joseph Reilly and James R. O'Donoghue. Pp. 367–377. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) 1*s*. [84

Imperial Forestry Institute: University of Oxford. Sixteenth Annual Report, 1939–40. Pp. 18. (Oxford: Imperial Forestry Institute.) [84

Thirty-eighth Annual Report, 1940–1941, of the Imperial Cancer Research Fund. Pp. 34. (London: Royal College of Surgeons.) [94

Proceedings of the Royal Society of Edinburgh. Section A (Mathematical and Physical Sciences). Vol. 61, Part 1, No. 4: On an Elementary Solution of a Partial Differential Equation of Parabolic Type, Part 1. By E. T. Copson. Pp. 37–53. 1*s*. 6*d*. Vol. 61, Part 1, No. 5: On an Elementary Solution of a Partial Differential Equation of Parabolic Type, Part 2: The Nature of the Singularity. By E. T. Copson. Pp. 54–60. 6*d*. (Edinburgh and London: Oliver and Boyd.) [224

Town and Country Planning Association. Forty-second Annual Report. Pp. 8. (Welwyn Garden City: Town and Country Planning Association.) [224

British Trust for Ornithology. Seventh Report, for the Year 1940. Pp. 12. (Oundle: British Trust for Ornithology.) [244

Other Countries

Imperial Council for Agricultural Research. Scientific Monograph No. 14: Further Studies on Cereal Rusts in India. By Dr. K. C. Mehta. Pp. vii+224+12 plates. (Delhi: Manager of Publications.) 6 rupees; 9*s*. 6*d*. [313

Union of South Africa: Department of Agriculture and Forestry. Pamphlet No. 222 (Chemistry Series No. 163): The Inoculation of Clover. By W. B. Goldschmidt and Dr. E. R. Orchard. Pp. 8. (Pretoria: Government Printer.) 3*d*. [24

Carvão de Santa Catarina. Relatorio a presentado em 1890 a o Governo da Republica pelos Luiz F. Gonzaga de Campos, Fabio Hostilio de Moraes Rego, João Caldeira d'Alvarenga Messeder. Pp. 91. Duas Notas sobre os Cimentos Nacionais—a Magnesia—os 'Compostos' do Cimento. Pelo Paulo Sá. Pp. 39. A industria e o Laboratorio: o auxilio dos Laboratorios às Industrias de Construção. Pelo Paulo Sá. Pp. 32. A especificação Brasileira para Cimento Portland e as tendências modernas sobre o assunto. Pélo Paulo Sá. Pp. 28. Metalografia das Ligas de Alumínio: alumínio-ferro. Por E. Orosco e Helena Brandão Orosco. Pp. 16+12 plates. Estabilização de solos. Pelo Paulo Sá. Pp. 51. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [34

Anuario del Observatorio Astronómico de Madrid para 1941. Pp. 300. (Madrid: Instituto Geográfico.) [34

Colony of Mauritius: Department of Agriculture. Tenth Annual Report of the Sugarcane Research Station for the Year 1939. Pp. 48. (Mauritius: Government Printer.) 70 cents. [84

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 51: Technological Reports on Trade Varieties of Indian Cottons, 1940. By Dr. Nazir Ahmad. Pp. vi+107. 1.8 rupees. Technological Bulletin, Series A, No. 52: Technological Reports on Standard Indian Cottons, 1940. By Dr. Nazir Ahmad. Pp. iv+110. 1.8 rupees. (Bombay: Indian Central Cotton Committee.) [84

Memoirs of the National Academy of Sciences. Vol. 23, Third Memoir: Observations and Measurements on the Members of the National Academy of Sciences. By Aleš Hrdlička. Pp. x+108. (Washington, D.C.: Government Printing Office.) 30 cents. [114

Smithsonian Miscellaneous Collections. Vol. 99, No. 19: Notes on Mexican Snakes of the Genus *Geophis*. By Hobart M. Smith. (Publication 3629.) Pp. ii+6. Vol. 99, No. 20: Further Notes on Mexican Snakes of the Genus *Salvadora*. By Hobart M. Smith. (Publication 3630.) Pp. ii+12. (Washington, D.C.: Smithsonian Institution.) [114

Punjab Irrigation Research Institute. Report for the Year ending April 1939. Pp. v+7+189+102 plates. Research Publication, Vol. 2, No. 24: Experiments for the Haveli Project on a Model of the Rivers Jhelum and Chenab Downstream of their Confluence. By Dr. N. K. Bose and L. Thakar Dass Gulati. Pp. 58+27 plates. 1.8 rupees. Research Publication, Vol. 2, No. 25: Experiments for Silt Control on a Model of the Emerson Barrage, Left Undersluices, Left Regulator, with a Part of the River Chenab Upstream. By Dr. N. K. Bose and Thakar Das Ghulati. Pp. 12+26 plates. 6 annas. Research Publication, Vol. 3, No. 4: The Formation and the Reclamation of Thur Lands in the Punjab. By M. L. Mehta. Pp. 54+17 plates. (Lahore: Government Printing Office.) [164

Canada: Department of Mines and Resources: Mines and Geology Branch, Geological Survey. Paper 40–15: Preliminary Map, Grave Flats, Alberta. By B. R. MacKay. 10 cents. Paper 40–16: Preliminary Map, Pembina Forks, Alberta. By B. R. MacKay. 10 cents. Paper 40–19: Preliminary Map, Bearberry, Alberta. By H. H. Beach. 10 cents. Paper 40–20: Preliminary Map, Assinica Lake, Quebec. By G. Shaw. 10 cents. Paper 40–21: Preliminary Map, Mishagomish Lake, Quebec. By G. Shaw. 10 cents. (Ottawa: King's Printer.) [174

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SCIENCE IN MODERN LIFE

DR. J. B. CONANT's address at the meeting of the Royal Society which followed a luncheon in his honour on March 20 added one more to the many utterances, among which Dr. Raymond B. Fosdick's review of the Rockefeller Foundation in 1939 is specially notable, indicating how clearly scientific workers in the English-speaking democracies have appreciated the seriousness of the threat to science and all other cultural and spiritual values of our civilization in Nazi power and philosophy.

It is true that, as President Roosevelt has said, unless we win there will be no freedom for either management or labour. The ultimate stakes are freedom of speech and expression, freedom of worship, freedom from wrong, freedom from fear. By winning we strengthen their meaning, increase the structure of mankind and strengthen the dignity of human life.

The struggle, however, no less than the reconstruction to follow, will demand some sacrifice of privileges until success is achieved. Restraints must be accepted for the service of security, the improvement of standards of healthful living and the provision of markets for manufacture and agriculture. In peace, as in war, clear and resolute thinking is required to determine the limits which can wisely be accepted without detriment to that creative thought, that fearless, disinterested search for truth upon which man's real progress always depends.

It is at this point in the relations of science and society that there is a decided clash between two schools of thought which has tended to darken counsel. The supreme importance of freedom of thought, of teaching and of investigation if science is to advance or even exist, and if creative minds are to be brought to bear on the solution of the many problems confronting mankind or to express in fresh forms the aspiration of man's spirit, is not doubted by those who stand together in the struggle against Nazi tyranny. It is no service, however, to that cause, to refuse to recognize, as Prof. M. Polyani and others do, that science itself is to some extent a social activity, the direction and extent of which are determined at least in part by the society in which the man of science finds himself.

Recognition of this fact, which has recently been ably argued in a pamphlet, "Science and Socialism", issued by the University Labour Federation, is fundamental to any constructive attempt to remedy the present position, or indeed ultimately to scientific advance itself. We have here one main and sufficient reason for the keen interest and sympathy of men of science everywhere in the struggle against domination to which the British Commonwealth is committed. They at least have been quick to recognize that the control of man over Nature, the making of the machine the servant and not the master of mankind, and that the "world of increasing hope and enjoyment for the common man, the world of honoured tradition and expanding science", of which Mr. Churchill has spoken, are not to be had in a world dominated by totalitarian tyranny of any form.

To maintain to-day the isolation of science from the problems of life, whether of war, of unemployment, of disease and poverty is as absurd as to maintain the mutual independence of electricity and magnetism. We must at least attempt to think dialectically about the relations of science with society if science itself is to exert its full creative and productive powers, still more if society is to attain that higher level of living and of civilization which scientific advance has already made possible.

To recognize, however, that science changes its social environment and is itself modified by that environment, that the extent of scientific resources and the direction in which they are used are dependent on the nature and outlook of the society in which the man of science works, is quite another matter from admitting the right of external authority to intervene in the quest for truth, enlarging the knowledge of the universe, which is of the essence of science. Scientific workers may not be able to obtain adequate support for carrying out a particular investigation unless they have succeeded in making its purpose sufficiently intelligible to enlist the sympathy of those controlling public funds. Their work is to that extent conditioned by the general outlook and culture of the community. It is another matter altogether if the community through its leaders or representatives should attempt to dictate the methods to be used and the results to be obtained in the investigation.

This is the point which is commonly overlooked by so many who have recognized the reaction of society on science. Their enthusiasm for the different position which, on paper at least, science and the scientific worker occupy in the U.S.S.R., sometimes betrays them into uncritical adulation of that position. "Science and Socialism", referred to above, is no exception. The planned control of scientific research does indeed imply that science is a concern of the State and establish the existence of a social function of science. It affords further evidence of the exiguousness of the distinction between 'pure' and 'applied' science. It emphasizes the need for every citizen to approach the problems of life with a scientific outlook.

To maintain further, however, that in such a society there is no distinction between the professional man of science and the layman is at once to incur the charge which Prof. Polyani brings against any totalitarian régime in the "Contempt of Freedom". There is no peculiar 'holiness' in science, and they do it a disservice who assert that science is something mysterious which cannot be comprehended by the ordinary citizen. To eliminate jargon and promote the effective exposition of what science is doing is one of the first duties of the man of science and one of the greatest safeguards of freedom of thought in a democratic society.

Scientific workers must admit the reactions on the direction and extent of their work which are imposed by the nature of the society in which they live. They can co-operate with their fellow citizens to widen those bounds and minimize any restraints. They can themselves seek to direct their work to serve the needs of society, the purposes of the community of which they are members. They can, however, in no wise admit the direction of their work by any external authority.

It is this allegiance and this clash of loyalties that is overlooked and obscured by so many writers of 'left' views. The danger of a totalitarian regime to scientific work and freedom does not depend on whether that regime is Communist or Fascist in political thought. The scientific worker's first allegiance is to truth itself, and his first duty to his fellow men the defence of feedom of thought and investigation and utterance. On that point there can be no compromise, and any support he may give to the furtherance of a political programme must not be inconsistent with that allegiance.

"Science and Socialism" betrays an obtuseness on this point no less lamentable than that of the Polyani school to the idea of planning. Scientific workers as a body are only too anxious to see society enjoying the higher standard of living, the ampler leisure and richer culture which science has made possible and to co-operate in the establishment of such an order. Their support cannot be given as implying unconditionable alignment with any political system or party. They must retain their freedom of thought and judgment. The scientific attitude cannot be abandoned even if it conflicts with an official social philosophy.

It can be readily admitted that there are many things to be redressed in the present order of society and that scientific advance itself has directed attention to such weaknesses. A capitalist society, however, has no monopoly of weaknesses and scientific investigation might equally lead to exposures calling for drastic reform under a socialist or any other conceivable order of society. The scientific worker cannot pledge himself in advance to keep silence as the price of support from any political party or system. He is first and foremost a servant of truth and bound to follow wherever she leads.

It is indeed possible that that loyalty might well lead scientific workers to a fairly general support of many tendencies generally regarded as socialist but for the excess which characterizes the statements of socialist propagandists as in "Science and Socialism". They have indeed no inherent objection to the planning of science, but whether that is done by men of science alone or in co-operation with others there are real difficulties. Mannheim's "Man and Society in an Age of Reconstruction" remains the outstanding contribution to the evolution of a type of planning in which democratic control could be maintained by institutional safeguards.

The continuance of scientific advance and the very existence of civilized society depend on the establishment of an ordered society in place of the anarchy and *laisser-faire* of the last twenty years. That in itself implies some measure of planning, and the urgent task to which scientific workers must make their own contribution is that of determining the conditions and technique by which we can advance to a higher form of freedom involving social co-operation and the maintenance of individual vitality and initiative in a planned society. This task will call for creative thought, for the steady widening of the fields in which scientific thought and method are brought to bear —an experimental attitude in social affairs and a readiness to learn from the lessons of history, which are far more characteristic of a democratic than of any type of totalitarian regime. Scientific workers can only make that contribution by clearing their minds fearlessly from all prejudices and preconceived ideas and by refusing to allow their loyalty to truth to be compromised by any support which they may, in the defence of freedom or the establishment of order and the furtherance of reconstruction, be called upon to give to a political party or institution. They must learn the art of co-operation with their fellow citizens, of interpretation and exposition, of spreading a scientific outlook and approach to the problems of society and of world order, abandoning all claims to be a class apart, without surrendering that higher loyalty which bids them follow wherever truth may lead them.

MIGRATION

Migration to and from the British Isles

Problems and Policies. By R. S. Walshaw. (Issued under the auspices of the School of Social Sciences and Administration in the University of Liverpool.) Pp. 94. (London: Jonathan Cape, Ltd., 1941.) 5*s*. net.

During the course of the present War population problems necessarily recede into the background. In a violent life and death struggle for our very existence as a nation, we do not need to consider, as immediately applying to our war effort, those interesting questions of births and deaths and migration which produce their effects over long periods of time. They have their grave importance in normal times, and they have had their cumulative effect in putting our man-power exactly where it is. If we were obliged—which God forbid—to contemplate a succession of gigantic world-wars, then the whole population structure would have to be studied with the single view of providing men for the services and for munition production, allowing only a minimum of those ineffective members of society who are chiefly to be found among the aged.

Mr. Walshaw's excellent little book is issued under the auspices of the School of Social Sciences and Administration in the University of Liverpool. The introduction is by Mr. Caradog Jones, reader in social statistics in that University, who rightly remarks that when peace comes again there will probably be an increase of public interest in migration questions. To show how such questions can affect even our war effort, we may quote his statement that the Dominions "are only ready to welcome the strong, the skilled, the intelligent." If such a drain of our best elements were to continue for any length of time, it is clear that the ultimate population would be less able to wage a successful war.

It is not always realized how large the drain has been in the past. Thus, during the nine years from 1905 until 1913 inclusive, the average net annual outward migration, from the United Kingdom, was 183,000; and even after the War of 1914–18 the average net annual outward migration for the six years 1921 until 1926, inclusive, was 120,000.

We all know how the birth-rate has been falling in Great Britain, and that the population, in spite of appearances, is not reproducing itself. Various estimates have been made as to the year in which we shall reach a stationary condition of population, and, as a rough guide, it may be said that if there had been no war, that condition would have been reached sometime about 1950. Now that we are at war we must expect that stage to be reached sooner. The author points out that, when we have reached a state in which there will be a natural decrease, in place of the increase to which we are accustomed, "the subject of external migration will begin to occupy a far more important place in the public mind than it does now."

One of the chapters deals with the ebb and flow of British migration to and from the continent of Europe, and it is stated that of the British in Europe in the year 1930, half were resident in France. "During the sixteen years 1922 to 1937 British immigration into the United Kingdom from Europe amounted to as many as 233,000 people". By the end of 1937 very few British subjects remained on the Continent, and one can read this with a certain sense of relief; though to counterbalance this we must remember that 67,000 British subjects are in the hands of the Germans, in the oldest part of the Empire, namely, the Channel Islands.

The most important matter discussed by the author is British migration to and from the Dominions, and he mentions the significant fact that, for the first time in our history, in 1931 we gained in population by inward migration. Most of those who came back were recent settlers who had failed to establish themselves and were stranded when the great depression arrived. With regard to the general question of migration to the Dominions, certain principles have been accepted by all the Governments concerned. It was, for example, agreed that a better distribution of the white population of the Empire is desirable, and that emigration required constant co-operation between the home and oversea authorities, and that full use should be made of the agency of such bodies as the Salvation Army, the Y.M.C.A., and so on. But the whole complex matter deserves study in the book before us, and Mr. Walshaw sets out clearly the various changes of policy and circumstance. A few matters stand out: thus, the Dominions have made it clear that they cannot absorb additional secondary producers unless there is a large increase in the number of primary producers.

On the question of the numerical effect of emigration from Great Britain, the author makes the following statement, which would seem to be incorrect: "In the British Isles . . . even after allowing for the losses of the war [of 1914–18], the cessation of emigration caused the population to be over a million more than it would have been had the pre-war trend continued". Actually it is easy to show that, if there had been no war, the population of Great Britain would have been some two millions greater than it actually was, as shown by the census of 1921.

It may be remembered that, at the International Population Congress, which was held in Paris in 1937, Prof. A. M. Carr-Saunders and Mr. Walshaw contributed a paper on recent population movements in Ireland, which raised the question as to whether the population of Great Britain was not likely, if present tendencies continued, to be eventually of predominantly Irish descent. Mr. Caradog Jones says in the introduction to this book, "Men accustomed to town life have been encouraged to settle in countries where the primary need is for workers on the land, their places being taken by countrymen from Southern Ireland". Mr. Walshaw remarks that "In view of the unimpeded influx of Southern Irish citizens into Great Britain . . . expenditure by the United Kingdom on the transference of its own citizens to the Dominions would already appear somewhat anomalous".

The question deserves impartial and objective study. To begin with, we must realize that southern Ireland is a small country and that the number of migrants that it sends out, nowadays, does not reach the huge proportions of the past. Southern Ireland uses emigration as a safety-valve, and its population remains nearly constant, with a tendency to decrease; between 1924 and 1936 the average excess of births over deaths was about 17,000 a year. The census of 1936 gave the population as 2,968,000, a diminution of 3,500 since 1926.

If we consult the figures of the census of Great Britain of 1931, we shall find that there were resident in Great Britain at that time, 359,163 persons who were born in southern Ireland; of these, 55,487 were living in Scotland. Taking the population of Great Britain in 1931 as practically 45 millions, it will be seen that the percentage of persons born in southern Ireland was 0·8. Of course, to those born in southern Ireland we should add those of Irish parents but born in Great Britain. There are indirect ways of getting at this figure, but not very exact. Perhaps the southern Irish now living in Great Britain might amount to 4 per cent of the whole population. There is some reason to suppose that this stock breeds rather more rapidly than the British stock.

As to quality, a large number of Irishmen who migrate to Great Britain find employment on heavy labouring work, but more than half the immigrants were women. The author thinks that some, at least, of the male immigrants are above the average in physical capacity. In the post-war world, this particular population problem should be studied attentively. Meanwhile, if the southern Irish now living in Great Britain throw in their lot whole-heartedly with the rest of us, during this period of the War, so critical for them as well as for us, we shall have no cause to complain.

EDUCATIONAL WORK IN THE UNITED STATES

(1) Educational Yearbook of the International Institute of Teachers College, Columbia University, 1940

Edited by Prof. I. L. Kandel. Pp. xiii+397. (New York: Columbia University, 1940.) 3.70 dollars.

(2) Student Teaching

An Experience Program. By Raleigh Schorling. (McGraw-Hill Series in Education.) Pp. xiii+329+33 plates. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 17*s.* 6*d.*

(3) Psychology in Education

By Herbert Sorenson. (McGraw-Hill Series in Education.) Pp. xiv+489. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 19*s.*

(1) THE determination of the English-speaking peoples to maintain educational thought and practice at a high level, even in the present distracted times, is illustrated by these three books from the United States. The first of them is the seventeenth annual issue (1940) of the well-known "Educational Yearbook", devoted on this occasion to problems of adult education. On this subject, profoundly important to democracy, the yearbook enables us to compare notes, not only with the United States, but also with the British Commonwealth of Nations, and with many other countries. One is not suprised to learn, however, that the editor found it "unfortunately impossible to secure articles from Soviet Russia and Nazi Germany".

The articles on Denmark and the Netherlands were written before the great devastation, and may still be taken, so far as they go, to represent the real mind of these stricken lands. As to England, it is here placed on record that adult education has been deemed far too important for maintaining the morale of the nation to be allowed to languish.

One of the general impressions left by a perusal of this comprehensive yearbook is that no definition of what is meant by adult education is yet possible. It may mean anything from courses at the university level to what the editor rather grandly calls "the liquidation of illiteracy"; that is, teaching people to read. Another clear impression conveyed by these reports is that sound adult education must come in response to the felt needs of the people, and from nowhere else. It cannot come by way of formal organization provided from above. "It is most successful and vigorous when it is spontaneous and springs from a desire to learn and an interest in self-education". At first sight it is strange to find that for adult education at its best we have to look to usually laggard England rather than to Scotland or the United States. This is partly due to the far greater provision for university education in these two countries, but partly also, we believe, to causes more creditable to England.

A remarkable fact, of special interest to readers of NATURE, is that even in English adult education there is only a slight demand for courses in science. Why, it may well be asked, should students in classes arranged by the Workers' Educational Association show such an overwhelming desire for social and literary subjects as to throw science definitely into the shade, notwithstanding the immensely important contribution of science to modern civilization? Even the relatively few science courses that are asked for are mostly elementary, and do not involve any serious scientific discipline. The report in the yearbook explains the fact by "the failure on the part of scientists to make clear the humane aspects of scientific study", and the inability of scientific specialists "to interpret their subject to others who are not specialists like themselves". But the recent provision of "mathematics for the million" is perhaps one sign among many that science is recovering its voice.

I am not sure, however, that this is the only way, or even the really effective way, in which science can be made to appeal to the more intelligent classes of the community. Men of science must, I think, address themselves to the task of breaking down the barrier set up last century between science and the humanities. It is not merely a question of making science easier to grasp, but a question of showing that science truly so called is from end to end as human as anything can be. The task will not be easy, for since the industrial revolution science has bestowed upon us not only marvellous benefits, but also an amount of noise, smoke and greasy dirt which apparently makes the W.E.A. student willing to forget science awhile, with all its works and ways.

(2) The breaking down of the old barrier between the scientific and the humane is exemplified in the work entitled "Student Teaching", a recent addition to the excellent McGraw-Hill Series in Education. The book is meant for students preparing to become teachers. Two generations ago, a similar book, whether British or American, would have contained no trace of the precision

which we associate with scientific method. A generation ago—*experto crede*—traces of that method began to appear. In the present volume the scientific method is well to the fore, chiefly in the form of statistics, charts, and "check-lists", some of which, by the way, would seem to most English teachers embarrassingly personal. The reader is supposed to be almost as well acquainted with intelligence quotients as with the multiplication table; but he is warned against accepting both as of equal validity.

Of course there is little that is of real scientific value in all these devices, but they do suggest that in pedagogy the scientific attitude has come to stay. Yet the author has written a rather jolly book, furnished with telling illustrations, and everywhere suggesting that a teacher deals with live children and not with laboratory abstractions.

(3) A further addition to the McGraw Series takes for its theme education as psychology sees it, there being few fundamental problems in education which do not find a place in Dr. Sorenson's book. They include the problems of growth and development, emotional reactions, behaviour, capacity to learn and the best methods of learning, measuring and marking achievement, and the forces of heredity and environment. The author adheres to no one school of psychology. He is, however, a thorough modernist. He represents in the main the new psychology of experiment, not the old psychology of introspection.

Dr. Sorenson's book provides a good example of the scientific humanism for which I would plead. It is to be hoped that the book will become known in Britain. Finally, I should like to see more evidence that the best British work in educational psychology (for example, that of Prof. Cyril Burt) is known in the United States.

T. RAYMONT.

CONTRASTS IN FIRST-YEAR GEOLOGY

(1) Introduction to Geology

General Geology, by Dr. E. B. Bailey; Palæontology, by Dr. J. Weir. Pp. xii+498. (London: Macmillan and Co., Ltd., 1939.) 18*s*.

(2) Geology

Principles and Processes, by Prof. William H. Emmons, Prof. George A. Thiel, Prof. Clinton R. Stauffer, Prof. Ira S. Allison. Second edition. Pp. xii+451. (New York and London: McGraw-Hill Book Co., Inc., 1939.) 21*s*.

A SUBJECT of such wide scope as geology cannot be presented fully in a first-year university course, and the difficult problem of selection must therefore be solved by lecturers in the way most appropriate to the needs of their students. The two first-year text-books under review are examples of solutions so extreme that neither is likely to correspond very closely with average requirements. The first covers an unusually broad field and deals with minerals, rocks, structures and map-reading, crystallography and microscopical petrography, physical geology, palæontology and historical geology. The second, by a group of authors, three of whom are at the University of Minnesota, is restricted to a much more detailed account of the materials of the earth and of geological processes; earth history is omitted, except for a table of the main divisions and outstanding events of geological time.

(1) The "Introduction", for which Dr. E. B. Bailey is largely responsible, is based on the first-year lectures delivered at the University of Glasgow during the years of his professorship (1930–37). The chapters devoted to palæontology are written by Dr. J. Weir and make up a little more than a quarter of the book. Another colleague, Dr. W. J. McCallien, has contributed two-thirds of the numerous illustrations, all of which are line drawings. Most of these are clear and effective, but a few of the more complex subjects are not very satisfactorily portrayed.

It is disappointing to find that Bailey's treatment of his topics is of very uneven value, both in manner and matter. His style of writing is highly individual and informal: somewhat journalistic, often graphic and entertaining, generally easy to read, but all too often marred by colloquialisms and carelessness of phrase and definition. As an example of inconsequential writing, the following would be hard to beat: "In some of the interior States of America it is laid down by law that salt must be fed to cattle. The reason is that our blood and other juices are salt solutions" (p. 78). Another curious statement (p. 115) is that the simple chemical composition of ore minerals is responsible for their habit of occurring in veins. The definition of a volcano—"an accumulation of material brought to the surface in a molten condition or by hot explosive gases" (p. 225)—is quite inadequate. Is a bed of volcanic ash a volcano?

The treatment of crystallography is very unorthodox, and the author's intention to help the student introduces difficulties that should not normally arise. The fact that the Miller indices of a crystal face are proportional to the parameters divided by the respective intercepts is not stated. What can a student be expected to gather from the statement that "The biggest index of a face symbol shows the axis-end from which the face starts" (p. 139)? The attempt to elucidate optical properties is seriously confused by the innovation (p. 161) of referring to the extinction directions of any birefringent section as X-er and Z-er axes (instead of saying they are relatively 'fast' and 'slow'), irrespective of the orientation of the section or of its uniaxial or biaxial character. Moreover, there are several mistakes. The refractive index of individual sections of a mineral in a rock slice is said to "range from zero to a definite maximum" (p. 162), and optic axes are said to be isotropic (p. 163).

The general liveliness of the book may be exemplified by the prophecies that much of the Yellowstone Park may be blown sky high within the next few thousand years (p. 76), but that during this time New York is not likely to be dangerously shaken by earthquakes (p. 244); and by the statement in a brief chapter on geophysical surveying that "A few good scientists believe that they possess the dowsing faculty". A particularly daring flight of fancy (p. 94) is that "What may be a single sill carries Stirling Castle, the Forth Bridge at Queensferry and long stretches of the Roman Wall in Northumberland (the Great Whin Sill of the North of England)". On p. 236 we read that "What is probably the same sill comes down to earth in the Lanarkshire coalfield". Actually, not even the 'Great Whin Sill' is a single sill.

In Part VII (pp. 381–479), which deals with historical geology, Bailey is at his best, and teachers and students alike will find this section both interesting and stimulating. This comment is equally true of Weir's highly competent survey of palæontology in Chapter v and Part VI. The biological aspects are much more thoroughly reviewed than in other elementary books and the student is systematically guided, with the aid of a profusion of admirably chosen illustrations, through the complexities of a subject that is here made much less forbidding than usual. The treatment is well balanced, vertebrates and plants receiving a full share of attention as well as invertebrates. Dr. Weir is to be congratulated on a presentation which is a model of its kind.

(2) The Minnesota "Geology" is the second edition of a text-book which first appeared in 1932. It has been revised, rearranged and completely reset, and in its now greatly improved form it becomes one of the best of the American books of similar scope. The first edition contained a chapter on earth history which has now been omitted, but other chapters have been expanded and new ones on sediments and igneous rocks introduced. There are also many new and original illustrations, by no means confined to subjects from North America, including beautifully reproduced photographs, well-designed block diagrams and other effective figures and maps, all of which add to the general appeal and educational value of the book. It was a happy thought to furnish many of the illustrations with inset maps showing unfamiliar localities. On the other hand, no locality at all is given for Welch's well-known photograph of a pothole in Glenariff (Fig. 137), which, moreover, is said to be after R. S. Tarr. In a few other cases the failure to indicate the scale of an illustration reduces its value; for example, Fig. 164, an arresting and highly instructive view of folds in the ice of the Ross Barrier.

The treatment is clear throughout, and generally logical and systematic; precise data are presented whenever possible; and the text is attractively written. The chapters on the atmosphere, natural waters, and sediments are particularly well done, though river meanders—always a difficulty—are unduly neglected. The clear distinction between processes of external and internal origin is somewhat blurred by the introduction of a class of sediments of magmatic origin and by the use of the term metamorphism to include replacement by groundwaters.

The later chapters, dealing mainly with internal processes, fail to reach the high standard attained in the earlier part of the book and are relatively old-fashioned in outlook. Another surprisingly bad definition of a volcano appears. This time "a volcano is an opening in the earth's crust through which hot rocks are thrown out" (p. 285). Details are given of many volcanoes and their eruptions, but they are not presented so as to build up a scientific picture, and no reference is made to the heroic and illuminating work of Perret. On p. 319 basalt is given as the aphanitic equivalent of peridotite as well as of gabbro. Magma formation is wrongly ascribed to relief of pressure by faulting and folding (p. 320). The gneiss figured on p. 389, and referred to as an example of a rock formed by dynamic metamorphism, is obviously a migmatite. Mountain building and other earth movements are said to be probably due to earth shrinkage. Alternative hypotheses receive no mention, nor is there any discussion of the many difficulties that stand in the way of accepting the shrinkage hypothesis.

A chapter on "Probable Conditions within the Earth" deals with geomagnetism and evidence from isostasy and seismology, but makes no mention of the outstanding work of Vening Neinesz. The nickel ore of the Sudbury intrusion is still given as an example of magmatic segregation, despite the fact that it is now known to be of later introduction (p. 423). The selected bibliographies with which most of the chapters are furnished require considerable revision. Some of the standard works to which reference is made have appeared in later editions than those cited.

Defects of the sort mentioned above make one hesitate to recommend the book as a whole for general reading, but so much of it is admirable that it should certainly be given a place in every college library. With further improvements on the lines indicated, a third edition, which should certainly be called for in due course, might well take first place among elementary text-books on physical geology.

PROGRAMME FOR SOCIAL REFORM

Programme for Victory
A Collection of Essays prepared for the Fabian Society by Prof. Harold J. Laski, Harold Nicolson, Herbert Read, Prof. W. M. Macmillan, Ellen Wilkinson, G. D. H. Cole. Pp. vii+187. (London: George Routledge and Sons, Ltd., 1940.) 5*s*. net.

THE common element in these six lectures is the belief of all the authors that something called the 'old order' is gone for ever, and that the only issue of our time is the question what is to take its place. Broadly speaking, the old order was the world of unplanned production and distribution on one hand, and international anarchy on the other. All are convinced that planning has come to stay, and that the independent State, certainly the small independent State, has no future. What they are not so certain about is whether this planning will or will not be carried out at the expense of personal freedom; whether we shall plan for social equality or for the protection of privilege; and whether it is to be conquest or the voluntary coming together of peoples in free supra-national associations which is to put an end to the proud sovereignty of the nation-State. It is the choice between these alternatives that the authors are concerned to shape.

Beyond this the word 'programme' is something of a misnomer. For with one or two exceptions there are no very concrete proposals in these lectures. There are general principles, and there is a good deal of eloquence. Prof. Laski is the most definite. He does say explicitly that a programme of social reform must be put in hand while the War is on, if fine words about democracy are to carry conviction to our oppressed allies. He suggests that that programme should include the repeal of the Trade Disputes Act, the abolition of the household means test, better allowances to the sick, the injured and the aged, and an effort to rescue public education from the rack and ruin into which it has been allowed to dissolve.

Mr. Harold Nicolson on world government is by contrast studiously vague. He says that he has deliberately chosen this title in order to avoid getting embroiled in the prejudices associated with "League of Nations" or "Federal Union". This tactful avoidance of prejudice, however, results in his telling us nothing at all about the kind of world government that he envisages, except that it would be a "loose Federation" based upon the "free co-operation of all free peoples". What kind of powers this Federation is to have, how it is to be organized, over what geographical area its writ is to run—for answers to such precise questions as these the reader will turn to this distinguished diplomat in vain.

Perhaps the most fresh and stimulating of all the contributions is that in which Prof. Macmillan deals with the problem of the British Colonial Empire. The significant fact upon which this lays emphasis is not that the Colonial peoples have been shamefully exploited (although sometimes they have); but that they have so little to exploit. We did not reduce them from a state of paradisical bliss to their present plight of disease and poverty. Their standards were wretched enough before ever the whites came interfering; and the great needs are, and always have been, money for development and for civilized services of all kinds.

In the remaining papers Mr. Herbert Read expresses fears lest a bureaucratic socialist State should stifle the voice of free artistic expression; Miss Ellen Wilkinson demands social justice; and Mr. Cole sums up with a moving plea for a liberal socialism which will combine the values of nineteenth century democracy with the techniques of twentieth century economics.

With the general attitude of these authors there will be widespread sympathy and agreement. But the book is not a programme. It merely gives an urgent stimulus to the demand that a programme consistent with this attitude should be quickly and precisely formulated. BARBARA WOOTTON.

A Junior Biology

By Kenneth C. Sparrow. Pp. viii+187. (London: William Heinemann, Ltd., 1940.) 4*s*.

THIS book is designed to cover a scheme of work for the first two years (of a five-years course), thus leading up to the School Certificate years. In biology, of all subjects, it is extremely difficult to make a judicious selection of material which will provide a connected and correlated course; but the author has succeeded well. Yet, many teachers of biology would be ready to join issue with the author for considering seeds and seedlings and the development of young animals so early in the course. Though the logical thing to do, from the biological point of view, it is exceptionally difficult from the educational point of view, for children are not familiar with seeds and seedlings, neither are they with incubating eggs. They are, on the other hand, with mature plants and birds, and that is where many teachers would prefer to begin.

There are some attractive photographs in the book, but they seem to have been chosen too casually; for example, Fig. 5, entitled "A Typewriter", shows more of a sturdy youngster than the machine it is intended to illustrate; the compression ignition engine cannot convey anything to a reader of such tender years, neither can the two excellent photographs of the development of the chick; the diagram of a model of the lungs would convey more if two illustrations were given representing the two extreme positions; and it is always misleading to group several animals or plants together without indicating their relative sizes as is done in Fig. 29 where the octopus is indicated as being not much bigger than the snail.

The book is essentially practical in outlook, which is all to the good. It should satisfy those teachers who accept this type of course. The work is so designed as to stimulate the spirit of discovering things and finding out their meaning. This is very desirable since though it may be that the young reader will forget most facts stated in the book, he ought to leave it with a real desire to discover things biological for himself.

Semimicro Qualitative Analysis

By William Lloyd Evans, Alfred Benjamin Garratt and Laurence Larkin Quill. Pp. vii + 246. (Boston, New York, Chicago and London: Ginn and Co., 1940.) 10*s*. 6*d*. net.

RECENT years have witnessed in inorganic chemistry the developments of a new technique involving analysis by semimicro methods, and the authors of "Semimicro Qualitative Analysis" have produced a most useful book for students in this field. A tremendous amount of detail, rendered more compact by an extensive system of abbreviations, has been compressed into this volume which includes five sections: an introduction describing apparatus, reagents and methods of procedure, one section each on the identification of cations and anions, a condensed outline of the theory of qualitative analysis, and finally a series of appendixes which is very comprehensive. The make-up of the book is somewhat novel in that it is of the loose-leaf variety, containing block outlines of methods, and flow sheets of experiments. It is therefore both a text-book and to some extent a laboratory note-book.

Semimicro analysis is not meant to displace the normal macroanalysis where larger quantities of materials are manipulated, but a course of this new technique supplies valuable training for a student since many of the rarer compounds are now, of necessity, analysed by micro methods.

The experimental details, which follow closely the better-known classical methods of analysis, are very clearly stated with ample explanations and directions. The theoretical part is couched in simple terms, but contains sufficient detail to enable the student to appreciate the methods employed in the experimental section. The appendixes will be found exceedingly useful since they contain much detailed instruction on the preparation of reagents, care of apparatus, general reactions of groups together with the usual tables of constants and lists of elements and symbols.

A course of microanalysis is almost essential now to aspiring chemists, and to such students this volume can be recommended with confidence as an indispensable item of their equipment.

Practical Pharmaceutical Chemistry

By F. N. Appleyard and Dr. C. G. Lyons. Fourth edition. Pp. vii+174. (London: Sir Isaac Pitman and Sons, Ltd., 1939.). 6*s*. 6*d*. net.

THE fact that this text-book by Appleyard and Lyons has made its fourth appearance in ten years is sufficient evidence of its popularity. This new edition differs from its predecessors only by a slightly expanded chapter on qualitative organic analysis.

Since this work is intended for those students entering for the Chemist and Druggist Qualifying Examination, it is not exhaustive, in that the work necessary for the Preliminary Scientific Examination is only reviewed briefly. Instead attention is focused on more advanced topics. At the same time adequate instructions and explanations are given of the principles underlying analyses of pharmaceutical products, particularly volumetric analysis.

The fact that the experimental details are condensed to fit in with a special curriculum probably accounts for the fact that some of the sections, for example, those on the assay of alkaloids and on permissible adulterants, appear rather short. In those sections and in the chapters on gasometric and gravimetric methods, the authors have obviously selected specimen examples to illustrate the technique required. The sections on organic preparations and organic qualitative analysis are very well done, and the field covered should prove adequate for the purpose of pharmaceutical students.

The practical work described in the text-book forms a suitable complement to the theoretical studies necessary in this course. Undoubtedly this new issue will maintain the high popularity earned by previous editions.

CARBON DIOXIDE ASSIMILATION IN HETEROTROPHIC ORGANISMS

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BEFORE 1936, only autotrophic organisms—plants and a small group of bacteria—were known to assimilate carbon dioxide. Recent experiments have shown that carbon dioxide is also assimilated by many heterotrophic cells, including animal tissues. Although this reaction provides no more than a small fraction of the total carbon requirements of heterotrophes, it is of great interest, for it is one of the metabolic processes which is indispensable for the normal life of animal tissues, bacteria and moulds.

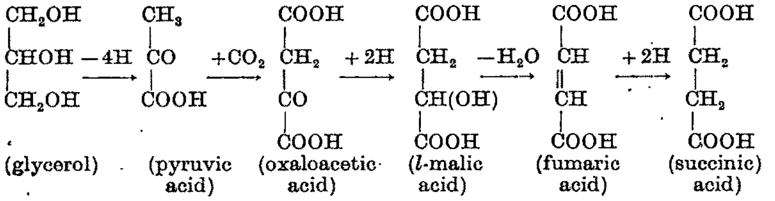
CARBON DIOXIDE ASSIMILATION IN PROPIONIC ACID BACTERIA

In 1936 Wood and Werkman[1], studying the fermentation of glycerol by propionic acid bacteria, made the unexpected observation that the end-products of the fermentation—mainly propionic and succinic acids—contained more carbon than had been added in the form of glycerol. Since the medium contained calcium carbonate (to neutralize the acids formed during the fermentation) the authors suspected that this might have provided the excess of carbon. In fact less carbonate was recovered than was originally present, and the authors thought it justifiable to conclude that propionic acid bacteria are able to utilize carbonate or carbon dioxide and to convert it into an organic compound. In 1938, Wood and Werkman[2] showed that the quantities of carbon dioxide used, and of succinic acid formed, are approximately equimolar. The experimental data conform with the assumption that there are two main reactions when glycerol is anaerobically fermented, namely :

$$(1)\quad \underset{\text{(glycerol)}}{CH_2OH.CHOH.CH_2OH} \longrightarrow \underset{\text{(propionic acid)}}{COOH.CH_2.CH_3} + H_2O$$

$$(2)\quad \underset{\text{(glycerol)}}{CH_2OH.CHOH.CH_2OH} + CO_2 \longrightarrow \underset{\text{(succinic acid)}}{COOH.CH_2.CH_2.COOH} + H_2O$$

Some of the intermediate stages of reaction (2) are outlined by the following scheme of Wood and Werkman[2,3] :

(3) 

$$(3)\quad \begin{array}{c} CH_2OH \\ | \\ CHOH \\ | \\ CH_2OH \\ \\ \text{(glycerol)} \end{array} \xrightarrow{-4H} \begin{array}{c} CH_3 \\ | \\ CO \\ | \\ COOH \\ \\ \text{(pyruvic acid)} \end{array} \xrightarrow{+CO_2} \begin{array}{c} COOH \\ | \\ CH_2 \\ | \\ CO \\ | \\ COOH \\ \text{(oxaloacetic acid)} \end{array} \xrightarrow{+2H} \begin{array}{c} COOH \\ | \\ CH_2 \\ | \\ CH(OH) \\ | \\ COOH \\ \text{(}l\text{-malic acid)} \end{array} \xrightarrow{-H_2O} \begin{array}{c} COOH \\ | \\ CH \\ \| \\ CH \\ | \\ COOH \\ \text{(fumaric acid)} \end{array} \xrightarrow{+2H} \begin{array}{c} COOH \\ | \\ CH_2 \\ | \\ CH_2 \\ | \\ COOH \\ \text{(succinic) acid)} \end{array}$$

According to this scheme pyruvic acid is the intermediate which actually fixes the carbon dioxide. The primary product of the fixation reaction is oxaloacetic acid ; this afterwards undergoes reduction to succinic acid.

Scheme (3) is now supported by three independent sets of observations :

1. The utilized carbon is present in the carboxyl group of succinic acid. This was shown by Wood, Werkman, Hemingway and Nier[4] with the help of carbon dioxide containing the heavy isotope ^{13}C.
2. Fumaric and malic acids, the postulated precursors of succinic acid, can be detected in the medium[5]. This applies to anaerobic conditions where succinic acid cannot be converted into fumaric and malic acids. Scheme (3) is the simplest, and therefore the most satisfactory, explanation for the simultaneous formation of the three dicarboxylic acids.
3. Added oxaloacetic, fumaric and l-malic acids are readily reduced to succinic acid as expected according to (3)[5].

It is probable that the assimilation of carbon dioxide by way of reaction (3) occurs in many other bacteria, although *B. coli* is so far the only other micro-organism for which the absorption of carbon dioxide has been directly demonstrated[4,6,7]. The occurrence of reaction (3) in other bacteria is indicated by the fact that they, too, form succinic acid from carbohydrate, glycerol or pyruvic acid. The evidence favours the view that the succinic acid is formed in these cases in the same way as in propionic acid bacteria, namely, through reaction (3). Experimentally, there is an important difference between propionic acid bacteria and other organisms ; in the latter the (assumed) uptake of carbon dioxide is counterbalanced by the simultaneous production of carbon dioxide ; carbon isotopes are therefore the only means of obtaining direct proof of the carbon dioxide fixation. The special position of propionic acid bacteria is due to the fact that from these organisms side reactions producing carbon dioxide are absent when glycerol is fermented.

CARBON DIOXIDE ASSIMILATION IN ANIMAL TISSUES

The discovery of carbon dioxide assimilation in animal tissues arose from a study of the fate of pyruvic acid in pigeon liver. This tissue is capable of synthesizing a 5-carbon chain from the 3-carbon compound pyruvate. Glutamine ($CONH_2.CH_2.CH_2.CHNH_2.COOH$) is formed from ammonium pyruvate[8], α-ketoglutaric acid ($COOH.CH_2.CH_2.CO.COOH$) from sodium pyruvate[9]. α-Ketoglutaric acid is very probably an intermediate in the synthesis of glutamine. The synthesis of α-ketoglutaric acid was found always to be accompanied by a synthesis of malic acid[7]. This observation provided the clue to the mechanism of the reactions taking place in the presence of pyruvic acid. Since α-ketoglutaric acid is known to undergo an oxidation to succinic acid and afterwards to malic acid, the simultaneous formation of α-ketoglutaric and malic acids might be expected if sufficient oxygen is available. However, a detailed investigation of the conditions under which α-ketoglutaric and malic acids were formed made it clear that the bulk of the malic acid could not have been formed by the oxidative breakdown of α-ketoglutaric acid. Thus the conclusion had to be drawn that a synthesis of malic acid from pyruvic acid takes place in addition to the synthesis of α-ketoglutaric acid.

When this was first observed[7] it was already known[10] that α-ketoglutaric and malic acids arise simultaneously when oxaloacetic acid is added to animal tissues. The following anaerobic reactions occur in the presence of oxaloacetic acid[10].

(4) oxaloacetic acid $\longrightarrow$ pyruvic acid + CO_2
(5) oxaloacetic acid + pyruvic acid $\rightarrow$ citric acid + CO_2
(6) citric acid $\longrightarrow$ α-ketoglutaric acid + CO_2
(7) oxaloacetic acid $\longrightarrow$ $l(-)$ malic acid

When oxygen is absent the reactions (5) and (6), which are oxidative, are each coupled with the reductive reaction (7), and the net effect of (4), (5), (6) and (7) is thus:

(8) 4 oxaloacetic acid $\rightarrow$ α-ketoglutaric acid + 2 malic acid + $3CO_2$

Since pyruvic acid yields α-ketoglutaric and malic acids in somewhat similar proportions the simultaneous synthesis of α-ketoglutaric and malic acids from pyruvic acid may be explained by the assumption that oxaloacetic acid is formed first from pyruvic acid and carbon dioxide:

$$(9)\quad COOH.CO.CH_3 + CO_2 \longrightarrow COOH.CO.CH_2.COOH$$

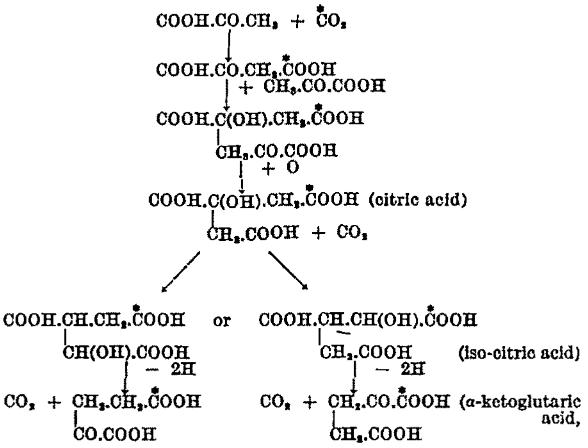
or

$$COOH.CO.CH_3 + H_2CO_3 \xrightarrow{-H_2O} COOH.CO.CH_2.COOH$$

and that this reaction, the 'carboxylation' of pyruvic acid, is followed by reaction (8). All the experimental results agreed with this assumption. Moreover, the rate of pyruvic acid disappearance was found to depend on the carbon dioxide pressure and this supported the view that carbon dioxide takes part in the metabolism of pyruvic acid.

SCHEME SHOWING THE FATE OF ASSIMILATED CARBON DIOXIDE IN PIGEON LIVER

(The carbon atom introduced in the form of CO_2 is marked with an asterisk. If a carbon isotope is used, two different forms of iso-citric and α-ketoglutaric acids both containing the isotope are formed.)



Yet the evidence could not be regarded as conclusive so long as the absorption of carbon dioxide had not been directly demonstrated. In living tissues there are always metabolic processes in which carbon dioxide is produced, and these more than counterbalance the carbon dioxide uptake. In the balance sheet there is, therefore, a production of carbon dioxide. The use of carbon isotopes is the obvious method of tackling this problem. If carbon dioxide containing an isotope is used, the α-ketoglutaric acid synthesized from pyruvic acid should contain the isotope, if the mechanism suggested by the reactions (8) and (9) is correct (see the accompanying scheme). The decisive experiment was carried out by Evans and Slotin[11]. They used carbon dioxide containing the radioactive ^{11}C and found that α-ketoglutaric acid, as expected, contained radioactive carbon. This result completes the proof of the occurrence of reaction (9) in pigeon liver.

EFFECT OF VITAMIN B_1 IN ANIMAL TISSUES

The rate of pyruvate utilization is much reduced in the liver of pigeons suffering from severe beri-beri, and addition of the vitamin restores the normal level of pyruvate removal[7]. This holds for conditions under which the synthesis of oxaloacetate from pyruvate and carbon dioxide is the chief reaction responsible for the removal of pyruvate and it may therefore be concluded that the 'carboxylation' of pyruvate is dependent on vitamin B_1. Since the carboxylation might involve more than one step—for example, a phosphorylation of pyruvate followed by the actual condensation with carbon dioxide—it remains to be investigated for which particular step of the carboxylation the vitamin is required.

Barron and Lyman[12] assume that vitamin B_1 is a general coenzyme of pyruvate which takes part in a number of different reactions of pyruvate. There are, however, important arguments in favour of the view that the vitamin is a specific catalyst of the actual carboxylation and that it is directly concerned with the formation of the C-C linkage. The vitamin has no effect on the rate of pyruvate removal in the *muscle* of B_1 deficient pigeons[7], and this indicates that the vitamin is not a 'general' coenzyme of pyruvate. A second argument is based on the principle of enzyme specificity and on what is known about the action of vitamin B_1 in yeast. In yeast[13] vitamin B_1 (in the form of its pyrophosphate ester combined with a specific protein) catalyses the conversion of pyruvate into acetaldehyde and carbon dioxide :

$$(10)\quad CH_3.CO.COOH = CH_3.CHO + CO_2$$

This reaction also occurs in moulds, plants and certain bacteria but is absent from animal tissues. The action of the vitamin in animal tissues must, therefore, be different from that in yeast. At the same time it is certain (Peters[14]) that here, too, the vitamin is concerned with the metabolism of pyruvate. Furthermore it is highly probable, in view of the high specificity of enzymes in general, that the reaction of pyruvate in animal tissues is analogous to (10). It has been suggested that this analogous reaction might be the "oxidative decarboxylation" of pyruvate leading to acetate and carbon dioxide :

$$(11)\quad CH_3.CO.COOH \xrightarrow{+\ O} CH_3.COOH + CO_2$$

But as we know of no biological catalyst capable of catalysing an oxidation in one case, and a non-oxidative reaction in another, it is difficult to regard the catalytic mechanisms of (10) and (11) as analogous. The carboxylation of pyruvate, on the other hand, is analogous to (10) : both reactions are non-oxidative, both involve a C-C linkage, and in both carbon dioxide is a reactant. They differ in that an α-ketonic acid is involved in (10) and a β-ketonic acid in (9) and in that (9), a carboxylation, is the reverse of (10), a decarboxylation. From the point of view of enzyme chemistry these differences are not fundamental, for it is known that one and the same catalyst can decarboxylate α-ketonic acids as well as β-ketonic acids[7] and that enzymic processes are reversible. The analogy between (9) and (10) is in these circumstances a very weighty argument in favour of the view that vitamin B_1 is specifically concerned with reaction (9).

The facts so far known do not make it necessary to assume that the vitamin catalyses other reactions in animal tissues, but it is by no means improbable that this is the case. McHenry[15] has shown that vitamin B_1 is necessary for the synthesis of fat in the intact organism. Since this is a complex process dependent on the supply of energy, the effect of the vitamin may be indirect ; but it is also possible that a condensation analogous to (9) in which carbon dioxide is replaced by a carboxylic acid, occurs in the synthesis of fatty acids and is directly catalysed by the vitamin.

EFFECT OF VITAMIN B_1 IN BACTERIA

In staphylococci, vitamin B_1 is known to be required for the 'dismutation' of pyruvate :

$$(12)\quad 2\ \text{pyruvate} \xrightarrow{+\ H_2O} \text{lactate} + \text{acetate} + CO_2$$

This was shown in a striking experiment by Hills who found that the rate of the dismutation is much reduced in staphylococci grown in a vitamin B_1 deficient medium and restored to the normal level by added vitamin[16].

If the function of vitamin B_1 in staphylococci is the same as in pigeon liver, that is, to bring about the synthesis of oxaloacetate, it should be possible to replace vitamin B_1 in Hills' experiment by oxaloacetate. Smyth[17] has shown that this is the case. In vitamin deficient staphylococci, oxaloacetate restores—temporarily—the normal rate of pyruvate dismutation. Oxaloacetate has no effect on "vitamin sufficient" cells. These facts are all explained if we assume that the vitamin acts by forming oxaloacetate from pyruvate.

It is not at once clear how the formation of oxaloacetate is connected with reaction (12). If the presence of oxaloacetate influences the rate of dismutation, as it does, the latter must be more complicated than the scheme (12) suggests. A satisfactory explanation of the oxaloacetate effect is afforded by the assumption that oxaloacetate participates in the dismutation. From what is known about the metabolism of oxaloacetate in other organisms, it is probable that oxaloacetate acts as a hydrogen carrier in the manner indicated by the following scheme :

$$(13)\quad \text{pyruvate} + \text{oxaloacetate} \xrightarrow{+\ H_2O} \text{acetate} + CO_2 + \text{malate}$$

$$(14)\quad \text{malate} + \text{pyruvate} \longrightarrow \text{oxaloacetate} + \text{lactate}$$

The net effect of these two reactions is (12). This hypothesis is supported by several experimental observations : the reduction of oxaloacetate to malate, and the oxidation of malate to oxaloacetate, postulated by the hypothesis, have been found to occur. Malate, moreover, has the same effect as oxaloacetate in vitamin deficient cells[17].

Biological Significance of Carbon Dioxide Assimilation in Heterotrophic Organisms

The significance of the carbon dioxide assimilation through reaction (9) obviously depends on the biological significance of the oxaloacetate formed by this reaction. So far two important functions of oxaloacetate are known. One of them, hydrogen transport in respiration, has already been mentioned. A second function is that of a parent substance of a number of essential cell constituents.

Hydrogen transport by oxaloacetate was first discovered in 1935 by Szent-Györgyi[18]. He observed that oxaloacetate is rapidly reduced to malate in respiring muscle tissue and that malate can undergo rapid re-oxidation to oxaloacetate. The system

$$\text{oxaloacetate} \underset{-\,2\text{H}}{\overset{+\,2\text{H}}{\rightleftharpoons}} \text{malate}$$

is now known to be an essential link in the respiration of many, if not all, animal tissues and also of a number of bacteria.

As a parent substance oxaloacetate takes part in the synthesis in animal tissues of a series of organic acids—citric, α-ketoglutaric, succinic, fumaric, malic acids—and of at least two amino acids, glutamic and aspartic acids and their respective amides, glutamine and asparagine.

Carbon Dioxide as a Growth Factor

Favourable effects of carbon dioxide on the growth of micro-organisms have been known since the work of Bang[19] in 1897, but early investigators believed that the effect of carbon dioxide was rather indirect, for example, by replacing oxygen and thus lowering the oxygen tension. More recently it has become clear that the effect is direct and specific. It has been found in numerous micro-organisms.

The widespread occurrence of the carbon dioxide effect may be taken to indicate that carbon dioxide takes part in some fundamental metabolic process, common to many organisms. The synthesis of oxaloacetate is a reaction sufficiently fundamental to offer an explanation for the necessity of carbon dioxide. This hypothesis can be experimentally tested. If it is correct, it should be possible to replace carbon dioxide by malate, or fumarate, or asparagine, or other substances which can serve as a source of oxaloacetate.

Carbon Dioxide and Anaerobiosis

The fact that air inhibits, or prevents, the growth of "anaerobes" can in many cases be explained by a simple chemical theory[20]: anaerobes lack the enzymic catalase, but at the same time they possess enzymes which cause molecular oxygen to react with the hydrogen of substrates. The end-product of this reaction is hydrogen peroxide. The latter oxidizes, and thus destroys, vital cell constituents.

The absence of catalase, however, does not account for *all* the inhibitory effects of 'air' on bacterial growth. Propionic acid bacteria (with the exception of one species) contain a powerful catalase. Yet these organisms grow poorly on the surface of agar, whilst growth is abundant in the deeper layers of agar stab cultures where the conditions are semi-anaerobic. Werkman and Brown[21] go so far as to call propionic acid bacteria 'anaerobes'. Van Niel[22] speaks of a "strong tendency towards anaerobiosis".

In a stab culture of a carbon dioxide producing bacterium the pressure of carbon dioxide will be greater inside the agar gel than on its surface, and it is in some cases feasible that the differences in surface and stab growth are due to these differences in the carbon dioxide pressure. It is easy to demonstrate that this view is correct in the case of propionic acid bacteria: the differences in surface and stab growth disappear when the cultures are kept in an atmosphere containing 5 per cent or more carbon dioxide. Under these conditions the organism grows readily on the surface of agar. Theobald Smith[23] carried out similar experiments on *Brucella abortus* as early as 1924.

The work reviewed in this article shows that carbon dioxide is an active metabolite in heterotrophic cells. It can condense with pyruvic acid to form oxaloacetic acid. By this reaction carbon dioxide is 'assimilated'. Oxaloacetic acid has at least two important functions in cell life; it acts as a hydrogen carrier in the energy-giving processes and is a parent substance of a number of cell constituents. Of special interest is the fact that the condensation of pyruvic acid with carbon dioxide depends on vitamin B_1.

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THE USES OF PSYCHOLOGY IN WAR-TIME

BY DR. C. S. MYERS, C.B.E., F.R.S.

PSYCHOLOGY and three of its applied branches —medical, educational and industrial psychology—have made enormous strides since the War of 1914–18. In 1914 these branches were in their infancy; to-day they may be said to have passed their adolescence. Indeed, industrial psychology has so widely developed that the term has become a misnomer. It is now concerned with all occupations, and (in developing vocational guidance) even with pre-occupational life: it should be styled 'occupational psychology'. In 1914 tests of intelligence were only just coming into general use in the medical and educational worlds. Now they are officially recognized by the Ministry of Health, the Board of Education and the Board of Control.

MEDICAL PSYCHOLOGY

In 1914 our present attitude towards the psychoneuroses ('functional' nervous disorders) and their treatment was only just developing. To-day that attitude is approaching stabilization, with maturer experience and the mellowing and blending of certain early crudities of the rival Austrian, French, German and Swiss schools. During the early years of the War of 1914–18 a 'shell-shocked' soldier wandering from his post in a psychoneurotic fugue (or trance) was regarded by Army disciplinarians either as a deserter fit only to be shot for his crime or as a madman certifiable as insane and destined for a lunatic asylum. But by the end of 1916 special hospitals for the reception of cases of war-neurosis and for their psychological treatment by medical specialists had been established in France, both at British bases and in army areas; and similar provision, together with special courses of training for medical officers, was being made at home.

Some of the many lessons learnt have not been forgotten during the present War, although so far the occurrence of war-neuroses has been comparatively rare. To each Army Command throughout Great Britain at the outbreak of war medico-psychological specialists were appointed, acting under a War Office consultant; and a special military hospital was established. A corresponding system was provided for the British Expeditionary Force, and by the Ministry of Health for civilians and soldiers. Intelligence tests, administered by psychologists, are now being officially employed to prevent the retention of men suffering from, or near the border-line of, mental deficiency. The recruitment of men so dull as to make it difficult for them to become satisfactory soldiers has always been a serious problem in war-time. It is especially grave to-day with the increased pace of modern warfare and with the greater skill demanded by a mechanized army. Advice has also been sought by the Admiralty from psychologists during the present War on the improvement of methods for the rejection of the colour-blind.

AVIATION PROBLEMS

The psychological laboratories of two British universities are now engaged in research on individual differences in the speed and degree of adaptation of the eye to darkness—a problem of especial concern to the Royal Air Force. For the same fighting service research is also being conducted on other psychological problems of flying, for example, on the kinds of error to which the pilot is most liable when subject to the stress and fatigue occasioned by prolonged periods of flying 'blind'. Other experiments having a war-time reference are also being carried out in psychological laboratories, for example, concerning methods of communication and concerning the effects of certain drugs and other chemical substances on mental efficiency.

VOCATIONAL GUIDANCE AND SELECTION

I well remember visiting one of our most distinguished mathematicians during the last War at Boulogne in 1915. I found him sorting and counting railway tickets in a small cabin in the marshalling yard of the harbour station! It took some time before his outstanding abilities were utilized in solving the problem of gunnery range-finding. To-day more systematic efforts are being made to avoid such errors of placement. All three of our fighting services are beginning to avail themselves of the psychological principles and methods of vocational guidance and selection which have been developed with increasing success during the past twenty years in choosing the best job for a given applicant and in choosing the best applicant for a given job. Throughout the various commands, army officers are now being trained by civilian psychologists in the application of some of these methods to recruits, so as to help in their selection for commissioned and non-commissioned rank and for special work (for example, driving or gunnery), and to reveal recruits of very low intelligence, within the various arms to which they have already been allocated. This scheme may be usefully extended to recruits *before* their allocation, to men, no longer recruits, who need transfer from work (for example, tank or pioneer) to which they have already been unsuitably allocated, and to the better selection and allocation of officers. To improve present methods, the War Office has recently appointed a small advisory committee of psychologists. The Royal Air Force is, correspondingly, employing civilian psychologists with the object of sorting out recruits already allocated to its air-staff; the psychological problems of selection of its ground-staff have as yet scarcely been touched. Tests have also been applied to naval units, and the Admiralty has lately invited a vocational psychologist to survey and to report on its present methods of education.

Several local investigations of a less official and less centralized character have also been carried out by psychologists at the request of army officers specially interested in the grading of recruits and their distribution to specialized work. For example, tests have been devised on behalf of a tank brigade for gunnery and for driving efficiency. The commander of an artillery regiment has invited psychologists to test the intelligence of his recruits, and has used the results to help in selecting such specialists as gun position officers' assistants, range-takers, etc. The intelligence has been tested of large batches of recruits in the Royal Army Medical Corps, whose scores were found to range from 0 to 94 (the maximum possible score being 100); the object of this inquiry being to assist in the classification of recruits and in their selection for special duties demanding a fairly high level of intelligence, including the work of instructors and of non-commissioned officers, and, in the case of the most 'backward' recruits, for an appropriate course of special instruction. At the request of a War Office directorate, the best methods of choosing instructors in a certain kind of technical work have been psychologically investigated; and certain recommendations have been adopted. All such work should lend no support to the current popular fallacy that the psychological methods employed in vocational guidance and selection consist solely in the application of tests. These are, in fact, merely accessories to other systematic methods based on psychological principles. They are invaluable servants, but must never be the masters, of the vocational psychologist.

TRAINING

During recent years the attention of certain industrial psychologists in Great Britain has been directed to improvements in methods of training. In most factories the novice has hitherto learnt his job and still learns it by passively watching a more expert operative, by listening to such words of explanation and advice as the latter may be willing or able to give while engaged on ordinary production work, and by 'trial and error' during subsequent routine practice. But the industrial psychologist now insists that training must be isolated as far as possible from production; that a 'school' for novices must be separately established; that the instructor must be most carefully selected; and that the course of training must be systematically planned. He urges this procedure because the expert operative cannot teach satisfactorily while busily engaged on production, and because he often proves a bad teacher, unable to describe what movements he uses or why he uses them, or even believing that he employs certain movements whereas actually he employs others. For the course of systematic instruction installed by the industrial psychologist, the easiest movements and the most advantageous position of parts and tools must have been previously determined. These are demonstrated and taught to the novice, and the reasons for adopting them must be carefully explained to him. As a beginner, he is taught always to inspect his products; and a 'museum of faults' is placed on exhibition, from which he may learn what errors he is likely to commit, how they may be avoided and how, if they do occur, they may best be dealt with.

These new methods of instruction have produced surprisingly good results. Not only have they enormously shortened the period of training, but they have also vastly improved the efficiency of the novices thus trained. They have proved of especial industrial value in war-time, when, as in many engineering works, unskilled persons are necessarily being engaged to take the place of semi-skilled workers who have had to be transferred to more highly skilled work. With appropriate modifications they appear to be also applicable to certain kinds of military training. But so far, in this connexion, during the present War, psychologists have been mainly employed by the fighting services in devising apparatus which will improve and facilitate training, and in addressing officers on the general principles of the subject, at training centres. Books and articles have also been published on the psychological factors involved in leadership, in propaganda work and in the causation of war.

WORKING CONDITIONS

Industrial psychology has afforded valuable help to firms engaged on Government contracts, in regard to the arrangement of shifts and the distribution of hours of work and rest-pauses, especially when, at the outset of war, excessive working hours were being urged. It has also helped to solve the difficulties of factory lighting and ventilation caused by the 'black-out', which resulted in unusual fatigue, absenteeism and higher labour turnover. For the Red Cross Society and Order of St. John of Jerusalem, an investigation in industrial psychology has been conducted into the easier packing and handling of parcels destined for prisoners of war.

SOCIAL CONDITIONS

Several systematic studies have been and are being conducted by educational and social psychologists on the effects on children of evacuation and air-raids; and other psychological investigations of similar, but wider, social import, under the ægis of one of the Ministries, can be reported.

This account does not by any means exhaust all the services that psychology is giving during the War. But it may serve to show the growing and increasingly recognized military, medical and social, practical value of the subject.

LA SOCIÉTÉ DE PHYSIQUE ET D'HISTOIRE NATURELLE DE GENÈVE

BY PROF. F. E. WEISS, F.R.S.

GENEVA has long been renowned as the home of eminent men of science. Some of these, the de Saussures and the de Candolles, belonged to families which, like the Darwins, have produced several generations of distinguished scientific men. It is no wonder, therefore, that the Physical and Natural History Society of Geneva has a deservedly high reputation, and that its *Memoirs* find a ready exchange with the publications of most learned societies. Last October the Society celebrated its hundred and fiftieth anniversary, and an account of the meeting of celebration fills the pages of the October number of its proceedings. The centenary celebration in 1890 was naturally made a great occasion and the centenary volume of the *Memoirs* of the Society contains a number of important scientific papers, as well as a history of the Society prepared by the secretary, Dr. A. H. Wartmann.

Like many learned societies, it had its origin in the desire of a number of men of various professions, but all interested in scientific discoveries, to meet and talk over their observations and theories. They met at first informally and probably at irregular intervals in each other's homes, and their number was for this reason naturally limited. For this reason also there seems to have been some doubt as to the exact time when the Society was founded. It really grew into existence. The first minutes of a meeting are dated August 5, 1791, but M. Vaucher, one of the originators of the Society, gives the date of its foundation as 1790, and this date has been by common consent accepted. No doubt even before that date the Society had an informal existence, for it possesses a manuscript which is said to have been read at one of its meetings in 1783. From the first minutes of a meeting mentioned above we learn that it met in the house of a M. H. A. Gosse, a pharmacist, and a laureate of the Paris Academy of Sciences. Among those present were L. Jurine, a surgeon and naturalist; J. Tallot, whose interests were geological; Pastor Jean Pierre Vaucher, head of a boarding-school and an eminent botanist, interested in freshwater Algæ, one of the most well-known of which has since been named after him. Other members who formed the nucleus of the Society, but who were absent from this first meeting, were M. A. Pictet, a lawyer and professor of philosophy, interested in physics and the applied sciences; Colladon, a pharmaceutical chemist, and the botanist Gaudy. This group of young amateurs, as Vaucher called them, was soon joined by other members of senior standing and already distinguished in various branches of science. They included H. B. de Saussure and his son Theodore, François Huber, well known for his researches on the life of bees, Pyramus de Candolle, the eminent botanist, and Henri Boissier, rector of the Academy and in charge of the instruction in applied botany. His natural history collection became the nucleus of the future National History Museum of Geneva.

It was decided to ask the veteran Charles Bonnet, then seventy-one years old, to become the honorary patron of the Society. This for reasons of health he refused. Being further pressed he accepted the position, but he died two years later, leaving a bequest to the Society.

Ordinary meetings of the Society still remained somewhat informal. The host at whose house the meeting was held presided and read a paper which was followed by a general discussion. Observations published in scientific journals were also discussed by the meeting. One of the original members tells us that the discussions were always amicable and that contributions by young members were welcomed and encouraged. Occasionally eminent men of science passing through Geneva were invited to the meetings. Such guests included Volta, Berthollet, Arago, Ampère, and others.

The strict religious tenets of the citizens of Geneva are reflected in the rules of the Society, one of which forbade any member or correspondent to admit publicly any religious principles that were not based on theism. Consequently the motto chosen for the Society was "Pro Deo et Natura".

In the early days of the Society—1792–1798—Geneva passed through stormy times, including a reign of terror in 1793 and ending in the annexation of Geneva by France in 1798. Except for an interruption of a few months in 1793, the Society continued its meetings, though they were occasionally prevented by untoward circumstances. When, after the restoration of Geneva to Switzerland, Pyramus de Candolle returned in 1817 as professor of natural history, he found the Society somewhat somnolent. He urged the institution of fortnightly instead of monthly meetings, and advised that the latter should be held in the lecture hall of the Society of Arts. This was done, and shortly afterwards it was decided to publish the *Memoirs* presented to the meetings, and up to date forty-one volumes have appeared containing 435 memoirs.

In 1890, when the centenary celebration of the Society took place ; it numbered 450 ordinary and 50 honorary members. The celebrations of the hundred and fiftieth anniversary which took place in October of last year, are described in a special number of the *Compte Rendu* of its meetings. They took place in the large hall of the Athenæum in the presence of some three hundred members, friends, and delegates from kindred Swiss societies. As the president, Mr. Revilliod, said in his opening address, with so much sorrow and misery in the world at large this was not the time to have great festivities, but it was deemed right to have a special meeting of the Society to remember the early days of its birth and growth and to honour its founders and the great men who contributed to its progress and prestige.

The subsequent speakers at the meeting included the Swiss Councillor for Public Instruction, the Rector of the University of Geneva, who dwelt on the close connexion between the University and the Society. This was emphasized by the subsequent addresses, in which three of the University professors dealt with the advances made in various sciences since the centenary celebrations of 1890. Prof. Weigel spoke of the progress achieved during the last fifty years in mathematics and physics. In connexion with the latter subject he dwelt on the important work done by Edward Sarasin and de la Rive in demonstrating the existence and the propagation of electromagnetic waves in space. The advances made by chemical researches in Geneva since 1890 were dealt with by Prof. Briner, while Prof. Fernand Chodat devoted his address to the progress of the biological sciences during the last fifty years.

The list of ordinary and honorary members of the Society elected between 1790 and 1940 follows the account of the meeting, and among the honorary members are the names of many British men of science, including Sir Joseph Hooker, Sir William Ramsay, Douglas Freshfield, and Sir Arthur Eddington.

OBITUARIES

The Right Hon. Lord Stamp, G.C.B., G.B.E., F.B.A.

LORD STAMP, Lady Stamp and the Hon. Wilfred Stamp were killed in a recent air attack on London. Lord Stamp was a man of whom many different obituary notices might be written. As a Civil Servant, as a business administrator, as a Government advisor and negotiator, as a writer on economic problems, he had so many achievements of distinction to his credit that adequate note of him in any one field crowds out reference to any other field. He worked as easily as ordinary mortals breathe or sleep. He could afford to say "yes" to innumerable invitations to speak or write on relatively unimportant occasions without losing power to do first-rate work on important occasions. His energy was incredible and his output superhuman. All this has been emphasized in one way or another by those who have paid tribute to his memory.

The branch of activity in which I came to know him best was different from any of those which I have named above. It was his activity in developing both the teaching of economics and research in it by others. In that field I learned what I believe to have been the central secret of his success and his public service.

Stamp was easily the most distinguished student produced by the London School of Economics and Political Science. He repaid his debt to the School many times over by the services which he rendered on the governing body from 1925, as vice-chairman of the governors from 1930 and, after the death of Sir Arthur Steel-Maitland in 1935, as chairman. In those positions his capacity and his prestige were of enormous assistance to an institution in a state of perpetual growth to meet an apparently inexhaustible demand. Growth implied both an external need for resources to feed it, and an internal need for adjustments to the changed scale and kind of activities. In solving the innumerable problems, external and internal, incidental to such growth and change, it was invaluable to have at hand a man of Stamp's humanity, justice and breadth of understanding. I remember well more than one question of policy or of important personal choice on which the power to rely upon him to come in and give judgment was of first-rate importance. His handling of problems was so transparently honest and so sympathetic to all the different arguments presented to him, that, however he decided any issue in dispute, those who were unsuccessful went away feeling little less happy than those who had succeeded. They were made able to feel, not that they had had a bad case, but that they had had a good case which had unfortunately encountered a rather better case on the other side. I have often felt, as so many others have felt, that if there was something affecting us which ought to be decided by someone other than ourselves, we would sooner have Stamp decide it than anyone else of our acquaintance. It was this gift of conciliation, of never quarrelling, even in disagreement, that made Stamp seem the indispensable person for so many important tasks of statesmanship and made him perform so well all those varied tasks.

William Beveridge.

Prof. Herbert Freundlich, For. Mem. R.S.

By the death of Herbert Freundlich in Minnesota on March 29 at the age of sixty-one, colloid science has lost one of its chief exponents. His remarkably comprehensive grasp of the literature of what had been up to his time a somewhat widely diffused collection of facts and *ad hoc* hypotheses permitted him to bring them into order and, indeed, into a logical system. His memory will long survive not only on account of his own contributions, but especially for "Kapillarchemie", his classical book on the subject, of which the fourth edition in two volumes appeared in 1930.

There are two predominant characteristics which we associate with Freundlich : the simplicity of his experimental technique, and his great influence as a teacher and inculcator of enthusiasm. It is a remarkable tribute to Freundlich that most of the important monographs on the specialized fields in colloid science which have appeared in the last twenty years have been written by authors who commenced their investigations with him. Whilst it is fairly customary for senior research men to spend some time in foreign universities, the particular piece of research work they carry out there is not often chosen as the main field of their future investigations, yet such was the case in the Dahlem Laboratory.

Freundlich's early work on colloid systems dealt with the preparation and coagulation of sols. Whilst this work covered much the same ground that Sir William Hardy had sketched out some years before, it led Freundlich to a more detailed examination of the various properties which sols can acquire in special circumstances. The general principles of the electric double layer had been laid down by Helmholtz and Smoluchowski : Freundlich was the first to show that the so-called electrokinetic (or Freundlich) potential was an entity distinct from the Nernst or thermodynamic potential, and by a series of important and interesting experiments he showed how variations in the electrokinetic potential and the concomitant change in colloid stability could be produced by the addition of electrolytes. He likewise examined and explained the mechanism of sensitization such as is noted in many biologically important systems and is readily demonstrated by the addition of albumin to a ferric oxide sol.

In 1923 Szegvary showed that a ferric oxide sol to which is added a suitable quantity of electrolyte sets to a gel which can be liquefied by shaking and resets to a lyogel on standing. This behaviour, termed 'thixotropy', was examined in detail by Freundlich, who showed that the same laws apply to thixotropic setting as in electrolytic coagulation, and that a variety of systems, including a number of great technical importance, such as the paints, can exhibit the phenomenon. In investigations which spread over many years, he showed that thixotropic systems are complementary to the dilatant systems of Osborn Reynolds, with a range of plasticity in between. The investigation of the phenomenon of streaming double refraction shown by sols of anisodimensional particles was another important investigation taken up with all the thoroughness and simplicity of experiment characteristic of Freundlich together with his co-worker, Zocher.

Among many other investigations initiated by Freundlich, the inquiry with Posnjak into the nature of swelling and the investigations on orientated adsorption in relation to catalytic activity must be mentioned as being especially interesting and suggestive. The adsorption isotherm, usually attributed to Freundlich, was in fact proposed and utilized by Boedeker and Wilhelm Ostwald, but Freundlich greatly extended its application, especially to capillary active solutions.

Freundlich was half British by birth ; he had many friends both in Great Britain and in the United States. Those of us who knew him well miss a colleague who was not only erudite, but also at the same time both extremely lively and interesting in conversation.

Eric K. Rideal.

I entered Freundlich's laboratory in Braunschweig, where he was professor on the Technische Hochschule, in 1911, working there and later in my own laboratory until the War of 1914–18. Shortly after the War, I translated his great work on colloid chemistry ; the second edition, about twice as long, has found no publisher in English. Freundlich in those days was very happily married to a beautiful *Rheinlaenderin* with the dark curly hair and blue eyes of the Celtic type so common in those parts. She was a brilliant pianist, as was Freundlich himself, for he had up to the age of nineteen pursued music as a career with the thoroughness and energy characteristic of his family. When he concluded that he would never be a great composer, he abandoned music for chemistry, success in anything but creative work being not good enough for him. His father was a Jewish manufacturer, his mother a Scotswoman, and the combination produced five sons of extraordinary but diverse abilities, Erwin, for example, having been the first astronomer to uphold Einstein's views.

The funds available to Freundlich for research were incredibly small—I believe about £60 annually. But he was one of those experimenters able to obtain fundamental results with the simplest means. His laboratory was one more example of the extraordinary fact that important work very frequently comes from badly equipped laboratories. He had an extraordinary aptitude for clearing up, by well-directed experiments linked with a critical examination of other results, groups of phenomena of the complicated type occurring in colloid chemistry. His later work in ultrasonics and thixotropy are examples of this.

Freundlich went to Dahlem in 1917, where for seventeen years he directed a large research school, and spent his happiest and most productive years. He left Germany (as a protest against Nazi interference with his choice of collaborators)—*schlagartig*—using, as he said, the Nazis' own slogan. He went to University College, London, taking his apparatus—a gift of the Rockefeller Foundation. But he was now a different man owing to a domestic bereavement rather than political persecution, which indeed he had only experienced in the persons of his assistants in Dahlem. For this reason, perhaps, his personality was much less appreciated than I had expected.

At the time of his leaving for the United States, Freundlich showed no signs of physical or mental enfeeblement. He is said to have died from a heart-attack, and he never took exercise. But he was a sparely built man, and in the Braunschweig days could walk many a sportsman off his feet when he chose. I sometimes wonder whether he did not take life "to heart" much more than ever he showed, and whether this last exile to an extremely trying climate may not have ended prematurely a life which might now be rendering Great Britain valuable services.

H. Stafford Hatfield.

Prof. E. F. Francis

Prof. E. F. Francis, who died on April 15, was a graduate of Victoria University (Liverpool) and of the University of Erlangen. He joined the staff of the Chemistry Department, University College, Bristol, in 1895, was appointed assistant professor in 1904 and became full professor in 1906. During this early period he played a very active part in the movement which led to the establishment of the University of Bristol, became a member of the first Council and impressed the mark of his personality on the institutions and organization of the new university. He was the second to fill the office of pro-vice-chancellor, which he held until his retirement in 1936, and during the period 1921–22, he was acting vice-chancellor. He became very well known in the city of Bristol and was largely instrumental in promoting the cordial relations which exist between the city and the university.

When he became professor in 1906, he took over the laboratories in the old building facing University Road, with two assistants and fifty students. On his retirement in 1936 the number of students had increased to more than two hundred and the teaching staff included two professors and nine lecturers. In 1908, he was responsible for the building of a new chemistry department, and with the able assistance of Dr. F. W. Rixon he supervised the building and equipment. This Department served as a model for other chemistry departments which were constructed in the years immediately following. He had a great sense of responsibility as to the function of a university professor in the training of the characters of his students. He established a school of physical chemistry at Bristol and with typical unselfishness he encouraged its growth at the expense of his own research school. On his retirement in 1936 his friends collected £2,500 for the endowment of a Francis Francis Scholarship for the encouragement of post-graduate work in chemistry.

Francis's researches, which were carried out in spite of heavy university duties, were very largely the work of his own hands. In some forty original communications to the learned societies, he covered a wide range of subjects in organic chemistry. He was interested in the condensation products between keto-derivatives and substituted anilines, the action of nitrosyl sulphide on organic substances, the catalytic decomposition of nitroso triacetonamine, which he employed for the estimation of hydroxyl ions, and other topics. He was especially interested in the preparation and properties of the long-chain carbon compounds. This interest first arose from his association with Prof. Sydney Young in joint publications in 1898 on the separation and oxidation of hydrocarbons. This led to a more extended research on the oxidation of paraffin wax which has aroused some attention as providing a possible means whereby waxes may be converted into fatty acids and thence to fats. In order to gain accurate knowledge of the materials composing paraffin wax, he studied the systematic building up of the longer hydrocarbon chains ranging from C_{18} to C_{46}. In the course of this work he has cleared up many obscure points in the chemistry of the natural fats and waxes. His advice was frequently sought and ungrudgingly given to other workers in this field. He set a very high standard in the purity of his products; his patience was inexhaustible, and he spared no pains in order to achieve this end. These products were employed in X-ray investigations, in measurements of heats of crystallization, dielectric constants, etc., which researches always received his enthusiastic encouragement. The standard he has set in this field of research will be difficult to surpass, although he was engaged up to within a few days of his death on an investigation which attempted to raise even his own high standards.

W. E. Garner.

NEWS AND VIEWS

Government Changes

IT was announced on May 1 that the King has been pleased to approve the following appointments: Minister of State, Lord Beaverbrook; Minister of Aircraft Production, Lieut.-Colonel J. T. C. Moore-Brabazon (see NATURE, **146**, 554; 1940: **147**, 344; 1941); Minister of Shipping and Minister of Transport, Mr. F. J. Leathers; Parliamentary Secretary, Ministry of Transport, Colonel J. J. Llewellin; Parliamentary Secretary, Ministry of Aircraft Production, Mr. Frederick Montague. The King has been pleased to approve that the dignity of a barony of the United Kingdom be conferred upon Mr. Leathers, and that Mr. Leathers and Colonel Llewellin be sworn of His Majesty's Most Honourable Privy Council. Mr. R. H. Cross, formerly Minister of Shipping, has been selected to fill the post of High Commissioner in the Commonwealth of Australia for His Majesty's Government in the United Kingdom. It is added that the amalgamation of the two Departments of Shipping and Transport for the purposes of the War will be effected forthwith. The details of this process will be worked out as speedily as possible and when the process is complete the combined Ministry will become the Ministry of War-time Communications.

Social and Technological Change

IN an article "Science in the Totalitarian State" in *Foreign Affairs* of January, W. Kaempffert points out that both Stalin and Hitler agree in requiring the university professor to serve the State, accept the tenets of the official ideology and eschew any excursions into the metaphysical or theoretical. In a totalitarian regime, the artist, man of science or philosopher must not only believe what he is told to believe by his rulers; he must also practise that belief. Objectivity is derided in both the Soviet Union and in Germany as unattainable and as anti-social. This insistence on the crushing of individuality assumes different aspects in the U.S.S.R. and in Germany because of different economic needs and social conditions, but Nazi and Soviet officials and professors go to incredible lengths in following their rules, and the totalitarian concept of the relation of science to the State is remarkably elastic. When political expediency so determines, the whole concept is modified and on the whole the pliancy of the scientific mind in both countries is remarkable.

Behind the ideologies of dictators and professional pliancy, however, Kaempffert suggests that there is more than political expediency, or blind obedience. Dissatisfaction with social structure may also be a factor. If the dictators are to be overthrown and democracy preserved, the part that science and technology have played in the rise of democracy cannot be ignored. Research results not only in change within science itself but also social change. The democratic method is to adapt social change to technological change. The dictators are trying to do the contrary. They have tried to control thinking, above all scientific thinking. Science is more than synthetic dyes or drugs, radio, aeroplanes, television —it is an attitude of mind. If Hitler, Mussolini and Stalin are to rule, the scientific attitude will have to be abandoned when it conflicts with the official social philosophy. If it is abandoned there can be no Newtons, Darwins, Einsteins. Science will be unable to make discoveries which will change the human outlook and with that outlook the social order. To preserve science as a powerful social force for good, the research physicist, chemist or biologist must be permitted to enjoy the fundamental freedom of democracy.

Marxists are right in maintaining that science has never achieved perfect objectivity. But there has been a brave, determined, continuous and on the whole successful effort to strip scientific investigation and theorizing of emotional and of personal predilections. Democracy flounders before it arrives at satisfactory solutions of its social problems, but it is better to flounder and progress than to follow the philosophy of a dictator and remain socially and scientifically static. Under a totalitarian regime science may indeed exist, but it will become frozen as art and science were in ancient Egypt.

The Carnegie Trust

THE thirty-ninth annual report of the Carnegie Trust for the Universities of Scotland covers the year 1939–40, and in addition to an abstract of the financial accounts for the year ending September 30, 1940, includes a summary of grants for the period October 1, 1940—September 30, 1941, reports upon the work of investigators under the research scheme during the year 1939–40, including a list of publications and summary of awards and payments as well as of the awards of fellowship, scholarships and grants under the research scheme, the report of the superintendent of the Laboratory of the Royal College of Physicians for the year 1939–40 with list of publications, and reports upon the work of Carnegie teaching fellows during the academic year 1939–40 with list of publications. Interim distributions for the year 1940–41 amounting to £50,760 have been allocated, or one-fifth of the quinquennial grant, attention being directed to the undesirability of proceeding with extensive building programmes. Of this £8,680 has been distributed to the University of St. Andrews, £13,800 to Glasgow, £9,200 to Aberdeen and £13,780 to Edinburgh with £5,300 to the extra-mural institutions. Of these sums £5,660 is to be expended on libraries, £39,850 for building and permanent equipment, and £5,250 for the endowment of teaching and general purposes.

Up to date, seven fellows and thirty scholars have intimated that their researches have been suspended on account of war service. Arrangements have again been made to keep the awards open for those now engaged on national duties so as to allow their researches to be resumed at a later date. Further, if a fellow or scholar has undertaken Government work within the universities, he is allowed by the Trust to do so subject to a certificate being obtained from the principal of the university for a fellow or from his supervisor for a scholar to the effect that the work is of that nature. Reference is made to work by Dr. Walter Tebrich under his fellowship in organic chemistry in collaboration with Dr. W. O. Kermack on compounds related to the sulphanilamide drugs, leading to many new pyridine and piperazine derivatives, and on the discovery of new antimalarials, involving syntheses in the benzcarbazole series. In connexion with grants to assist investigations in organic chemistry the report refers to work on derivatives, of acridone related to the sulphanilamide drugs, and to work on the polysaccharides of ribwort seeds and of Irish moss. The report of the superintendent of the Laboratory of the Royal College of Physicians, in addition to further reference to the work of Dr. Tebrich, also refers to other work on antimalarials carried out by Dr. A. P. Weatherhead and by Mr. W. Webster on the synthesis of phenanthroline compounds derived from *m*-phenylenediamine.

Zoos in War-time

The annual report of the Zoological Society of London, presented at the annual meeting on April 29, shows that, despite a drop of about half the income and attendance figures down to about a third of the normal gate, some two thousand animals have been maintained at Regent's Park, and it is intended to maintain the zoological collection until full activities can be resumed after the War. In 1940 seventy-eight mammals, including an onager, fifty-five birds, and twenty-four reptiles were bred at Regent's Park, and two Rheinhardt's argus pheasants have been reared. Damage from more than 120 fire and explosive bombs has been less than expected, only the rodent house and zebra and wild ass house being seriously damaged, and the young giraffe, 'Boxer', bred at Whipsnade, died of a dilated heart due to over-exertion caused by fright. A few antelopes died of damage caused by fright. Damage to the monkey hill, camel house, ravens' aviary, aquarium and north gate can be made good, while bomb craters at Whipsnade can be relined to serve as dew ponds. The work of the prosectorium is being continued, with the usual examination of blood parasites and bacterial flora, research on the protozoan and helminth parasites of fish, and the routine examination of animals for helminth ova to facilitate preventive measures.

The report of the North of England Zoological Society shows the increasing receipt of animals from other zoos like Bristol, Dudley and Edinburgh to its zoological gardens at Chester for the duration of the War, and of special war-time feeding successes, notably waste chicken heads for leopards and lions, horse-flesh for pelicans, and dried, crumbled stale bread for cranes and pheasants, porridge for sun bears. In the difficulty of losing its male keepers for the services, this Society has had disappointing results from the appointment of girl keepers. The griffin vulture was bred for the first time in Great Britain, and the young bird is now thriving: the adults laid again on March 19.

American Message to British Zoologists

American men of science are not forgetful of their colleagues in Great Britain, and many letters expressing interest in conditions in Great Britain tell of the concern they feel. The American Society of Zoologists has expressed its goodwill in the following cablegram, received by the President of the Association of British Zoologists (Prof. J. Ritchie): "The American Society of Zoologists recently in session at Philadelphia sends greetings and encouragement to its British colleagues. L. V. Domm, Secretary". Needless to say, British zoologists warmly appreciate this friendly message, and look forward to a reunion in Great Britain with their American friends when, as J. B. Priestley suggested, the streets shall be blazing with light and all the windows shall be illuminated—but not through the agency of incendiary bombs.

Agricultural Meteorology in India

A fairly detailed account of a year's research work in agricultural meteorology is to be found in the official annual report of the Agricultural Meteorological Section, India Meteorological Department, for the year, 1938–39 (Pp. vi + 48. Simla: Government of India Press, 1940). The Imperial Council of Agricultural Research again financed the section, although proposals for making the Section permanent were under consideration by the Government of India. The Central Agricultural Meteorological Observatory, which is situated in the grounds of the Agricultural College, Poona, extended the scope of its work. This was made possible through the gift of an additional plot of land to the Observatory by the College. Experiments were continued at the Observatory on the rate of ascent of moisture through typical soils and its rate of evaporation from their surfaces. A 30-ft. tower was erected on the new plot for the investigation of variations with height of wind, humidity and temperature. Instrumental development included the design of an instrument for measuring the amount of rain or irrigation water lost by evaporation and by percolation and that actually retained in those layers of the soil with which plants are concerned. A few instruments of this design were made and preliminary trials of them begun.

'Precision' observations for showing the effect of weather on certain crop yields were continued at Poona and Karjat, and trials of statistical methods of sampling for the estimation of crop yields were made. Statistical investigations were also continued of a number of other subjects which have particular importance for agriculture apart from their general meteorological interest, among them being that of the date and type of the onset of the south-west monsoon along the west coast of India and of the evidence for the influence of afforestation on climate in the Singhbhum District. A notable result of the Section's activity in liaison between meteorology and agriculture can be seen in Appendix I of this report, which is a long list of experimental farms at which meteorological instruments have been installed, with details of each lay-out.

Timber Utilization in Malaya

MALAYAN Forest Records No. 13 (Caxton Press, Ltd., Kuala Lumpur, 1940), by H. E. Desch and A. V. Thomas, is not intended to replace the standard text-books, but to provide local timber users with a minimum of information necessary for the correct use of Malayan timbers under Malayan conditions. The paper, which is fully illustrated, deals with the subject on the well-known lines of: anatomical structure of wood, identification and classification of Malayan timbers, seasoning, defects, preservation, mechanical properties of timber, and design in relation to correct utilization of timber in new buildings. The authors have commenced their work by giving an account of the forest administration, climatic factors, types of forest, timber resources and forest policy of Malaya, sylvicultural operations, timber requirements of the future, exploitation, methods of extraction, and financial aspects—somewhat unusual information to find incorporated in what is admittedly a handbook for timber users. The authors make a noteworthy admission. As a result of their investigations—and they have had predecessors in India—they state that in connexion with the tropical and semi-tropical forests it is not possible to draw a hard-and-fast line between the commercially productive and the protection forests; nor is it possible to calculate with any degree of accuracy the potential annual production of timber to be obtained from these types of virgin forest. The volumes per unit of area obtainable from the latter bear no relation to an equivalent area of commercial forest in temperate regions.

Protection of Buried Electrical Cables

IN the *Bell Laboratories Record* of January, Mr. R. P. Ashbaugh describes how the lead sheath of a buried electric cable can be protected against soil corrosion. These buried cables have been used extensively in rural areas instead of aerial cables for several years. In several localities in the United States, cases have frequently occurred where small rodents such as gophers have gnawed the cables, puncturing the sheath and so letting in moisture, which ruins the insulation. Two layers of substantial steel tape protect the cable conductors against inductive interference from power lines and also against gophers, but they are expensive, and a cheaper construction was therefore sought. The construction adopted consists of a single overlapping layer of impregnated paper, a single layer of thin steel tape applied helically with just sufficient gap to allow for normal bending, a second overlapping layer of impregnated paper, and one or two layers of impregnated jute roving. Floodings of asphalt compounds are applied over the sheath and over each protective layer of paper and jute. About 130 miles of this new construction has been furnished for the buried portion of the Stevens Point - Minneapolis cable, and a considerable number of small orders for territories that are gopher-infested have also been manufactured and installed.

The Stockholm Technical Museum

THE Tekniska Museet of Sweden has recently been installed in new buildings in Stockholm, erected with funds provided by the Knut and Alice Wallemburg Foundation. The Museum was originally opened in 1923, and it has been assisted by many industrial companies and private persons. In view of the important contributions to engineering, metallurgical and chemical progress by many eminent Swedes, the Museum should prove a worthy addition to such institutions. There will be a Hall of Fame and in this will be the busts of Polhem, Swedenborg, Celsius, Ångström, Rinman, John Ericsson, Carlund, Nobel, De Laval, Wenstrom, Brinell and others. An outstanding exhibit is an original tower clockwork shown running, designed and built by Polhem. It was moved to the Museum from St. Mary's Church in Stockholm, where it had been running from 1765 until 1910.

Vital Statistics of London County Council

THE interim report of the London County Council Medical Officer of Health and School Medical Officer for the year 1939 contains the following information: The residential population for the middle of 1939 was 4,013,800, as compared with 4,062,800 at the middle of 1938. The marriages registered in London during 1939 numbered approximately 54,461, or 27·1 persons married per thousand of the population. The live births allocated to London during 1939 were approximately 52,366, as compared with 54,495 in the previous year. The live birth-rate was 13·0 per thousand, the rate for 1938 being 13·4. The deaths in the total population of London during 1939 numbered 46,377, giving a death-rate of 12·3 per thousand, as compared with 11·4 in 1938. Of the total deaths 22,554, or 48·6 per cent, were among females. There was an increase in the number of fatal street accidents—from 363 in 1938 to 519 in 1939. The deaths under one year of age per thousand live births were 47, compared with 57 in the preceding year. This constitutes a new low record.

Dr. Heinrich Kisch

DR. ENOCH HEINRICH KISCH, an eminent balneologist and gynæcologist, was born on May 6, 1841, at Prague, where he received his medical education and qualified in 1862. In the following year he settled in Marienbad as a balneologist, and largely contributed to making that town a health resort. In 1867 he was appointed lecturer, and in 1884 extraordinary professor in balneotherapy, at the medical faculty of Prague. In 1868 he became editor of the *Allgemeine balneologische Zeitschrift*, and later of the *Jahrbücher* *für Balneologie*. His principal original works in balneology were "Handbuch der allgemeinen und speciellen Balneotherapie" (third edition, 1875) and "Grundriss der klinischen Balneotherapie" (1897), while his chief gynæcological publications, in order of their appearance, were "Über den Einfluss der Fettleibigkeit auf die weiblichen Sexualorgane" (1873), "Das klimakterische Ältern der Frau" (1874), "Die Sterilität des Weibes" (1895), and "Geschlechtsleben des Weibes in physiologischer, pathologischer und hygienischer Beziehung" (1904), which was translated into English by M. Cedar Paul in 1910 under the title of "The Sexual Life of Woman". An autobiographical work entitled "Erlebtes und Erstrebtes: Erinnerungen" appeared in 1914. He died at Marienbad on August 24, 1918.

Gustave Le Bon

DR. GUSTAVE LE BON, a prominent psychologist, ethnologist and natural philosopher, was born at Nogent Le Notru, Eure-et-Loire, on May 7, 1841. He started his career as a medical officer in the French Army and served in the Franco-Prussian War of 1870–71, but afterwards gave up the practice of medicine and travelled extensively in Europe, Africa and Asia. In 1884 he was ordered by the French Government to report on the Buddhist monuments in India. The results of his investigations were published in "La Civilisation de l'Inde" (1884) and "Les Monuments de l'Inde" (1894). He is best known, however, for his works on psychology, especially "La Psychologie des foules" (1895), which went through twenty-seven editions and was translated into many foreign languages. He also wrote on psychology in relation to the French Revolution, the War of 1914–18, socialism and education. His chief contributions to natural philosophy consisted in his "Évolution de la matière" (1905) and "Évolution des forces" (1907). An anatomical and mathematical study on variations in the size of the cranium won him a prize from the Paris Academy and the Anthropological Society of Paris. He was founder and for some years director of the Bibliothèque de philosophie scientifique. He died on December 14, 1931.

Announcements

PROF. A. V. HILL, M.P., one of the secretaries of the Royal Society, has been elected a foreign associate of the U.S. National Academy of Sciences.

AT a recent meeting of the official and family trustees of the British Museum, Cardinal Hinsley, Archbishop of Westminster, and Sir William Bragg, director of the Royal Institution, were elected to the Trust.

DR. E. L. KENNAWAY, of the Royal Cancer Hospital, London, and Dr. J. W. Cook, regius professor of chemistry in the University of Glasgow, have been awarded the annual Katherine Berkan Judd prize of a thousand dollars by the Memorial Hospital for the Treatment of Cancer and Allied Diseases, for outstanding contributions to the knowledge of the cause and cure of cancer during 1939 and 1940.

A DECREE depriving Mlle. Eve Curie of French citizenship and confiscating her property was signed by Marshal Pétain in Vichy on May 5.

AT the anniversary meeting of the members of the Royal Institution held on May 1, the following officers were elected: *President*, Lord Eustace Percy: *Treasurer*, Sir Robert Robertson; *Secretary*, Major Charles E. S. Phillips.

A NEW institute of hygiene and medical chemistry has recently been established at Göttingen.

AT the recent meeting of the Indian Science Congress at Benares, the Indian Society of Genetics and Plant Breeding was inaugurated. The following officers were elected for the year 1941: *President*, Rao Bahadur T. S. Venkatraman; *Vice-Presidents*, Dr. W. Burns, Mr. K. Ramiah; *Secretary*, Dr. B. P. Pal; *Treasurer*, Dr. S. Ramanujam; *Councillors*, Dr. V. K. Badami, Dr. B. S. Kadam, Dr. J. S. Patel, Dr. T. S. Sabnis. The Society will publish a journal in which papers on genetics, plant breeding and cytology will be published.

A MEETING for the inauguration of a Radiography Group of the Institute of Physics will be held at 6.0 p.m. on May 20, in the Lecture Hall of Messrs. Kodak, Ltd., Harrow. All who are interested in the uses of X-rays in industry, whether members of the Institute of Physics or not, are invited to attend.

THE following awards for 1940 of the Institution of Mining and Metallurgy have recently been announced: Consolidated Gold Fields of South Africa Limited Gold Medal to Mr. C. R. Julian for his paper on "Underground Mining at Rio Tinto, Spain"; Consolidated Gold Fields of South Africa Limited Premium of forty guineas conjointly to Mr. J. Spalding and Mr. T. W. Parker for their paper on "Air-Conditioning Plant at the Ooregum Mine-Kolar Gold Field"; William Frecheville Students' Prize of ten guineas conjointly to Mr. J. E. Denyer and Mr. K. C. G. Heath for their paper on "Mining and Milling Tin-Tungsten Ore at Mawchi Mine, Burma". The Council has also elected Mr. H. K. Picard to honorary membership, in recognition of his distinguished services to metallurgy.

MESSRS. CHARLES BAKER, of 244 High Holborn, London, W.C.1, are desirous of making an appeal to readers of NATURE to offer for sale certain apparatus which they are able to release for work of national importance. The whole of the British scientific industry is engaged on the production of apparatus for war purposes, the result being that the supply of instruments required for research, education and routine inspection work is severely limited. The demand for such instruments is constant, and increasing from every quarter, not only from official sources, but also from the industries engaged on work of the greatest importance. The following apparatus is of special interest: microscopes, optical equipment and accessories, telescopes, balances, spectrometers, refractometers, surveying apparatus, slide rules and drawing instruments.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Physiological Origins of Cellular Potassium

EQUATIONS describing potassium equilibria across cells have been considered in a previous communication[1], and more fully elsewhere[2], with experimental proof of the principles involved with respect to potassium accumulation. Such potassium equilibria are largely conditioned by the nature of the products formed in the cell, especially the phosphate esters, and by the characteristic permeabilities of the membrane. That there is some association of potassium with phosphate is evident if only from an inspection of ash analyses, but the real problem for this special cation accumulation has lain in the manner of its occurrence and physiological significance. With this latter, or functional value, as distinct from mechanism the present communication is concerned.

At the outset we may consider a freely distensile membrane permeable to univalent cations and anions (which latter with plasma external to the cell may be either uni- or divalent, since divalent anions are in negligible quantity).

The following equation then applies (neglecting activity considerations in an initial presentation):

$$\eta/V + \Sigma b_1 + \Sigma d_1 = c, \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where η/V is concentration of indiffusible substances in cell; Σb_1 is concentration of diffusible cations; Σd_1 is concentration of diffusible anions; c is total external concentration; V is volume of cell water, which may be taken as unity for the normal cell condition, so that:

$$\eta = c - (\Sigma b_1 + \Sigma d_1). \quad . \quad . \quad . \quad . \quad (1a)$$

Also,

$$\varepsilon = \Sigma b_1 - \Sigma d_1 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where ε is the excess of anion over cation equivalents for the indiffusible substances within the cell.

From equations (1*a*) and (2), and using the Donnan relation, we can write:

$$\eta = c - \sqrt{(\varepsilon^2 + 4\Sigma bd)}, \quad . \quad . \quad . \quad . \quad (3)$$

where Σb and Σd are the concentrations of the diffusible ions external to the membrane.

Considering frog plasma, and expressing concentrations as millimols per litre (and not including in '*c*' neutral molecules freely diffusible across the membrane), we have from equation (3):

$$\eta = 230 - \sqrt{\varepsilon^2 + 4 \times 111 \times 108},$$

or when ε is zero

$$\eta = 11.$$

With a *p*H value necessarily within 7·0 and 8·0 in such a cell, ε for the protein alone will be about 50 or more, and even if this is balanced in part by indiffusible base, this latter will only use up the small available concentration for η. The arrangement would therefore appear to be a very disadvantageous if not an impossible one for the cell, which under the conditions could accumulate no appreciable amount of phosphate esters (and these it may be noted will contribute about double or more their molal values to ε). The position is somewhat worse if the cell membrane be permeable also to divalent cations, and when permeable to cations only and not to anions, or vice versa, no free inorganic cation or anion could be accumulated during the formative period of the cell.

If, however, we consider the cation permeability limited a stage further to exclude sodium but not potassium (while anions up to the level of inorganic phosphate can also pass), then the condition greatly alters to the advantage of the cell. Equation (3) becomes:

$$\eta = 230 - \sqrt{\varepsilon^2 + 4 \times 2{\cdot}6 \times 108};$$

or, when ε is zero:

$$\eta = 197, \text{ instead of the previous } 11,$$

much the greater part of the total concentration being thus available for indiffusible material within the cells.

When the value of ε is 124, as it appears to be in the living muscle, then η is in turn as high as 102, and for the muscle immersed in the cold and sustaining various potassium equilibria, the two values are almost identical at approximately 104 each. It will be seen, therefore, that the arrangement is of the greatest advantage to the cell, securing the balance of protein anion charges as also the charges on the phosphate esters by inorganic cations derived from without, while at the same time securing a wide range of possible concentration for indiffusible molecules or ions.

Such considerations apply not only for plasma, but also for sea-water in contact with cells having distensile membranes. Even for algæ with membranes not freely distensible the selective permeability to potassium still offers the advantage of securing adequate conditions without large internal pressures. For the non-distensile cell membranes of the root or absorbing cells of land plants, we must seek a further explanation. The special permeability could here be regarded as the retention of a condition evolved in a primitive marine environment, but it would seem better to limit the consideration to real advantages. One of these would relate to the pore size, which is less than if sodium ions were allowed through and may help, therefore, in retaining valuable substances within the cell. A more important point is probably the following. The total concentration of potassium in the soil is more constant than sodium and appears to be better adsorbed and held on the surface of soil particles. If the absorption of salts is determined—as we may expect from thermodynamical considerations—by the product of the diffusible cation and anion concentrations, and if in turn the synthetic processes within are dependent on the concentrations—necessarily minute—of nitrate and phosphate ions, then a greater uniformity of growth and nutrition will be secured when the cation permeability is limited to the potassium level.

Edward J. Conway.

Department of Biochemistry,
University College,
Dublin.
March 24.

[1] Conway, E. J., Nature, 144, 709 (1939).

[2] Boyle, P. J., and Conway, E. J., *J. Physiol.* (in the press, 1941).

Effect of X-Rays on the Regeneration of Root Cuttings

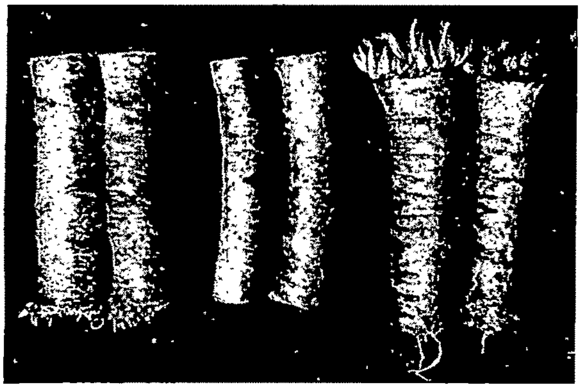
Root cuttings (thongs) of seakale (*Crambe maritima*) are known to exhibit marked polarity. In a former communication[1] a method was described of producing buds at the morphological base of a thong by periodic decapitation of both apex and base over a period of eight weeks. A working hypothesis, recently elaborated as a result of subsequent experiments[2], was also outlined regarding the correlation between auxin and meristematic activity. It was suggested that relatively low and high concentrations of auxin controlled the formation of bud and root initials respectively.

A recent experiment carried out here with the use of X-rays not only adds support to this hypothesis but has also resulted in the production of buds at the base of a thong within two weeks from treatment.

Skoog[3], irradiating *Avena* coleoptiles and solutions of heteroauxin with X-rays, claimed that the growth-substances involved were inactivated. Since the seakale root contains auxin[2], thongs were subjected to X-rays with the intention of reducing the total amount of growth-substance in the tissues and thus preventing, as a result of polar transport, the presence of a relatively high concentration at the base.

New thongs, 8 cm. long, cut transversely at each end were used. The parts of the thong treated with X-rays were as follows: (1) upper 3 cm. of the thong; (2) lower 3 cm.; (3) whole 8 cm. Each treatment was divided into three lots and irradiated with 1,000, 5,000 and 25,000 r-units respectively. A normal set of thongs was used as a control. Following treatment with X-rays the thongs were incubated in sand at a temperature of 20° C. and afterwards classified according to their appearance after eighteen days.

Control thongs produced buds at the apex and roots at the base (see accompanying figure, C). The dosage of 1,000 r-units had little effect on the regeneration of thongs in all treatments although root production was slightly decreased especially in (3). However, using concentrations of either 5,000 or 25,000 r-units, thongs receiving irradiation on the upper half produced buds at the base whilst their corresponding apices were inactivated (A); those irradiated on the lower half formed buds apically and remained inactive basally. Thongs given total irradiation remained inactive (B).


A B C

A, buds basally, apex inactivated. *B*, ends inactivated. *C*, normal thong.

From these results, it appears probable that there is a critical dosage which could be given to the middle regions of the thong for the purpose of partially destroying the auxin supply and thus eventually causing the formation of buds at both ends. Further experiments will be carried out to verify this point.

I am indebted to Prof. R. H. Stoughton for the supervision of this work and also to Metropolitan-Vickers Electrical Co., Ltd., who kindly consented to carry out the X-ray irradiation of the seakale thongs.

Wm. Plant.

Department of Horticulture,
University of Reading.

[1] Stoughton, R. H., and Plant, W., Nature, 142, 293 (1938).

[2] Plant, W., *Annals of Bot.*, N.S., 4, 607–616 (1940).

[3] Skoog, F., *Science*, 79, 256 (1934).

Ovarian Damage in Mature Baboons produced by Progesterone and Œstradiol Benzoate

It has been repeatedly shown[1] that the administration of progesterone in amounts of 15–20 mgm. to normal adult baboons in the first part of the cycle (eighth–tenth day) will cause the turgescent perineum to undergo deturgescence, and premature bleeding supervenes within 5–8 days of the last injection. Any quantity of progesterone more than 3 mgm. and less than 15 mgm. will only cause perineal deturgescence.

Examination of the ovaries of baboons treated in this fashion surprisingly reveals the development in one ovary of one or two follicular cysts which may be four times the size of a normal ovary.

Cystic ovaries therefore have been induced in primates by a hormone other than A.P. or A.P.L. substances.

The administration of a single injection of 0·5–5·0 mgm. œstradiol benzoate to baboons in the first part of the cycle will also cause perineal deturgescence which lasts 12–16 days instead of 5–8 days as after progesterone. The experimental cycle is prolonged by 18 days, that is, menstrual bleeding occurs on the fifty-sixth day instead of the usual thirty-eighth. Both ovaries of such œstrogen-treated baboons show degeneration of the stratum granulosum of all the follicles which contain follicular fluid.

If œstradiol benzoate is given daily to baboons from the eighth day of the cycle, then the perineum continues to rise and may be maintained in a state of turgescence for as long as the injections are continued. The ovaries display massive atresia of follicles and there remain only a few apparently unaffected fluid-containing follicles.

If both œstradiol benzoate (1 mgm.) and progesterone (5 mgm.) are simultaneously administered on the eighth day of the cycle the perineum undergoes deturgescence. A large cyst is produced in one ovary and massive atresia of follicles in both.

The second or third cycle succeeding those which were disturbed experimentally may not deviate very much from the normal.

Œstradiol benzoate, progesterone or a combination of both hormones given to normal adult baboons in the first part of the cycle causes widespread ovarian damage, albeit, perhaps, of a temporary nature.

JOSEPH GILLMAN.

Department of Anatomy,
University of the Witwatersrand,
Johannesburg.
March 21.

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[1] Gillman, Joseph, *Endocrinology*, 26, 80, 434 (1940).

Time as an Imaginary Fourth Dimension of Space is Incoherent

IT may be profitable in relation to current paradox to inquire very briefly into the relation of time to space. Consider two adjacent localities, one around a centre P and the other around a centre Q. The familiar conical diagram asserts that for any sublocality that is within a certain cone centring on P the relative time is real, while outside that cone it is pure imaginary; and likewise for a cone centring on Q. These cones intersect: and there are regions R, inside one of them and outside the other, for which time is real in relation to P and imaginary in relation to Q, or, in current language, the region around R is time-like in relation to P but space-like in relation to Q. This is something far more complex than the properties of a simple continuum such as a practicable space.

The paradox here suggested may be traced back into the ultimate foundations. The doctrine of the Principle of Special Relativity has been condensed into the slogan that "Henceforth Time and Space are no more". The mathematical Theory of General Relativity has been built up around the postulate (memoir of 1916, English edition, § 3, p. 117) that "the general laws of nature are to be expressed by equations which hold good for all systems of coordinates, that is, are covariant with respect to any substitutions whatever (generally covariant)".

The present critique has been stimulated by the observational result that the vast universe of the spiral nebulæ may be in a state of uniform expansion[1], for this suggests the question to determine the formulæ which express that expansion, as the formulæ of the Lorentz transformation express a uniform motion of translation. To my surprise, there appears to be no such set of formulæ. Thus permanent uniform expansion is impossible, so that in the course of time this expanding universe will cease to be uniform; which, by the way, is an alternative mode of accounting for the actual defect from uniformity that has been recently announced. But much more than this, the restriction of permanent uniformity to uniform translatory motion of the frame of reference carries us 'back to Newton', as the phrase goes, and may be even held to provide the explanation of this restricted indeterminacy of his frame of reference in space and time.

All such restrictions appear to be in flat contradiction to the postulate quoted above of General Relativity. The explanation is perhaps not far to seek: for if there is no longer time or space, there cannot any longer be velocity as the mode of expressing motion. But the formulæ here sought, and relations expressed in terms of them, would involve the velocity of one frame of reference relative to the other. Therefore such relations could not express laws of Nature: and these laws would have to be reformulated in terms of variables which probably have no intuitive relation to knowledge based on observation as given by our actual senses. The purely mathematical constructs of Ricci, now named tensors, are perhaps intended to be the foundation of a (very limited) formal universe expressed by variables of this kind. Meantime, the present astronomy, the queen of the mathematical sciences, would remain provisionally.

The reply to this critique might be to ask what is the alternative. For the tensor theory has led to a few results, of extremely special type, some of which have been in part confirmed. An answer appears to be that the tensor theory is far too wide a frame for the actual universe of Nature, which involves six freedoms, three for position and three for motion, whereas the tensor framework works with ten variables (potentials), so that the universe of Nature would have room, so to say, to rattle about in it, while as regards some of the specially simple test questions that are practicable the four extra variables may not come into play.

There can be a further claim, that a systematic doctrine of a duly restricted progress of dynamical Action of the system in time, can profitably absorb the valuable elements of these theories which are a natural general foundation for physics, and of the wave-mechanical as well, by going back a century to utilize W. R. Hamilton's procedures.

JOSEPH LARMOR.

Holywood,
Northern Ireland.
April 7.

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[1] NATURE, 147, 175 (1941).

Malaria in War

WITH reference to the interesting paper on malaria by Dr. V. B. Wigglesworth in NATURE of April 12, p. 436, I offer a short account of the methods used at Taranto during the War of 1914–18.

In 1917 the lines of communication for Salonika, etc., were taken through France and Italy to Taranto. In that year the rest camp at Taranto was hurriedly organized and with some 60,000 men passing through there were some 600 cases of malaria. In the winter of 1917–18 it was decided to deal with mosquitoes there; and to deal with all swamps, etc., within 2,000 yards of the camp. Colonel Robertson, R.A.M.C., was our expert, with great experience in India, of such work.

As Director of Works, Italy, I wired to the Director of Works, France, "Send me your best Land Drainage expert for Taranto." He replied, "You have got him—try Kenworthy" (who was then in charge of R.E. Stores at the base). Major Kenworthy in civil life was a land drainage consulting engineer.

Kenworthy with his experienced eye at once saw that excellent work had been done by the Italians; but that owing to a technical omission the ditches had been allowed to relapse. So he cleaned them of growths; and dug a smaller trench at the bottom of small section to deal with low-water flow and maintain sufficient velocity, while the old ditches dealt with floods. Some tile drainage was required also. Various farms had wells with buckets which were good breeding places. However, the farmers were pleased to have them sealed when Kenworthy gave them good pumps to replace the buckets. Hollow places in the olive trees were filled with mud. A few puddles after rain required attention. Robertson kept a small squad of men catching mosquitoes with butterfly nets. He plotted the catches on a large-scale plan, disregarding sporadic ones ; so that when groups of mosquitoes were shown, an examination would reveal some hollow tree missed or something else easily put right.

The cost was £4,000, whereas I had been expecting ten times that sum. About the same cost was incurred in fitting wire gauze to the huts, which in this case proved unnecessary. As a result in 1918, with some 120,000 men passing through, we had only five cases of malaria. Of these, three were men who went out of bounds (one was a man sent out of bounds on duty), and one was unexplained. I suppose that cases of malaria returning from Salonika were not counted.

The inference seems to be : take a good malariologist, a good land drainage engineer and give them a free hand.

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Colchicine-induced Tetraploids obtained from Plants of Economic Value

FROM the work of Kostoff[1] and others we have learned that length and number of the chromosomes are decisive in determining the value of derived tetraploids. Long chromosomes diminish fertility much more than short ones do. The greater their number, the lesser their viability. In consequence one has to choose from plants possessing a reduced number of chromosomes of moderate length.

Furthermore the purpose for which the plants are grown must be taken into consideration. After doubling the chromosome number, tobacco plants will lose their subtle properties of quality almost immediately. Tetraploid fibre-plants, however, may greatly augment the yield. We should therefore consider, whether the important properties are of a quantitative or qualitative nature.

Another fact must be remembered, namely, that creating a tetraploid means producing a completely new biological system. Finally, the action of colchicine may bring forth structural and numerical changes, chromosome breakages, etc., providing a new basis for unbalanced chromosome complements, variability and sterility.

The above-mentioned points were studies on tetraploid *Nicotiana tabacum* L. (Vorstenlanden and Virginia tobacco) and tetraploid *Hibiscus cannabinus* L. (Java jute, Ambari hemp, Decan hemp, Bimlipatam jute).

Tetraploid tobacco was obtained as usual and without difficulty by seed treatment. First of all it was noticed that the tetraploid strains still could be recognized by constant characters, although the general properties had been greatly altered. All tetraploid tobacco plants were smaller than the original diploids. This is in accordance with the large number of comparatively long chromosomes ($2n = 48$) tobacco possesses.

As the enlarged cells contain more chloroplasts, which have not increased in volume, the leaves are darker green. We can assume the production of carbohydrates per unit of leaf surface to be stimulated. This is of interest in the case of Virginia tobacco, the sugar content of which plays an important part in estimations of quality.

The increased leaf thickness makes it possible to produce cigarette tobacco with more 'body', although too thick a leaf may involve difficulties during the process of 'flue curing'. The fine quality of cigar tobacco is completely spoiled by the coarseness of the tetraploid leaf. Moreover the latter is supported by a very irregularly developed framework of veins.

However, here we have to recognize a difference between the primary and the secondary colchicine effects[2]. In most cases the properties of tetraploid plants, grown from treated seeds, are unfavourable, although the Virginia leaf sometimes showed good structure and shape. Diploid tobacco already being a multiple tetraploid, we find a great variability among the offspring of the tetraploids. Most of the plants still closely resemble the mother plant, but some of them tend to improved leaf structure.

Tetraploid Virginia tobacco differed from tetraploid Vorstenlanden tobacco in two other points : the percentage of pollen sterility of the former was higher, while its root tips (so far as I could examine them) contained the diploid number of chromosomes. In root tips of cigar tobacco I always counted about 96 chromosomes.

Many aberrations of merely theoretical interest in the structure of flowers and leaves were found.

A new fact is the occurrence of a number of somatic gene mutations, some of which may obtain practical importance. Their progeny will be examined in order to test the quality.

Tetraploid plants from Java jute (a fibre-plant) were obtained with some difficulty by treating apical meristems with colchicine solution or with the emulsion prescribed by Warmke and Blakeslee[3].

Hibiscus cannabinus is more resistant to diseases as compared with *H. Sabdariffa* (Rosella). On Java the latter is cultivated because the yield is higher. Tetraploid Java jute may combine higher yield with greater resistance.

In this case the chromosomes are small and the cells only contain a moderate number of them ($2n = 36$). Therefore we do not expect very pronounced differences between the diploids and the tetraploids. The experimental results confirm the expectation.

Marked differences in rate of growth, which are characteristic of tobacco, are not observed. In this respect cultivation of the tetraploids meets with no difficulties. Furthermore diploid and tetraploid types closely resemble each other.

The tetraploids may be distinguished by the following characteristics. The plants are ramified to a lesser degree, the leaves show a strong tendency to remain undivided. The tetraploids also show stiff, dark green and thick leaves, broad petals, a strongly developed epicalyx, a high percentage of pollen sterility, stomata with larger diameter, big seeds. In cross-sections of root tips, 72 chromosomes could be counted.

N. P. BADENHUIZEN.

Proefstation voor Vorstenlandsche Tabak,
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Netherlands East Indies.

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[1] *Chron. Bot.*, **5**, 17 (1939).

[2] Cf. Blakeslee, *Amer. J. Bot.*, **26**, 163 (1939).

[3] *J. Hered.*, **30**, 419 (1939).

RESEARCH ITEMS

Genetical Calculations

I. M. H. ETHERINGTON (*Proc. Roy. Soc. Edin.*, B, **61**, 24–42 ; 1941) shows that a linear algebra may be constructed which corresponds to genetical phenomena relating to gametes and zygotes. By using this algebra on the usual genetical symbols of a cross it is possible to alleviate laborious calculations of the results of types of mating and population studies. The author shows that the derived algebra differs from the usual in that $P \times (Q \times R)$ does not equal $(P \times Q) \times R$.

Triploid Newts

R. B. GRIFFITHS (*Genetics*, **26**, 69–88 ; 1941) has produced triploid and haploid newts by refrigerating eggs at close to 0° C. for about twenty hours after fertilization. Out of 100 eggs raised to swimming larvæ, 80 were triploid, 10 were diploid, and 10 were haploid. Since no triploid larvæ arose from refrigeration delayed half-an-hour after fertilization, it is suggested that the second maturation division is inhibited by refrigeration and the second polar body is retained in the egg. Triploid larvæ have larger nuclei and cells in the epidermis, erythrocytes and other parts, but show no gigantism ; the number of cells is fewer than in the diploid. Seventy-five of the triploid larvæ showed normal development and fifteen of these were examined during metamorphosis and found to be female. The haploid larvæ were dwarfed and more or less œdematous.

Genetics of Aquilegia

B. SCHAFER (*J. Gen.*, **41**, 339–348 ; 1941) has summarized the results of her genetical experiments on *Aquilegia vulgaris*. The allelomorphic genes *Bb* for blue-pink flower colour, *Cc* for tall-compact habit, *Ll* for blue-lilac flowers, and a multiple allelomorph series *A*, *aw*, *a* for fully coloured, white-faced, and completely white flowers were studied. *c*, *l* and *a* form a linkage group with cross-over values of 0·0428, 0·136 for *C*—*l* and *l*—*a* and 0·1523 for *c*—*a*. In one family, complete linkage between double flowers and tall habit was found while in another two families independence was observed. The aberrant results in the first family might be due to an inversion of a chromosome. The interspecific relations of species of Aquilegia are discussed.

Germination of Orchid Seeds under Sterile Conditions

THE possibility of growing orchid seedlings under sterile conditions, once regarded as almost impracticable, has of recent years, in part through the work of Knudson, been carried out so successfully that, in effect, orchid hybridization and subsequent seedling production has become a standardized and very profitable technique, and the work of a few growers is probably still contributing appreciably to British export efforts. But it does not follow that Knudson's claims are as firmly established that, in Nature, the usual fungus symbiont is simply necessary because its digestive activities supply soluble sugars from organic substrates—within or without the seeds. D. G. Downie has recently shown in her careful studies of the germination of the relatively rare British orchid *Goodyera repens* Br. (*Trans. and Proc. Bot. Soc. Edin.*, **33** (1), 36–51 ; 1940) that the seeds germinate readily under aseptic conditions in the presence of sugar, but not in mineral nutrient solutions over a wide range of *p*H. If the endophytic fungus is present, then no outside source of carbohydrate is necessary to start germination. By a wide range of experiments, she brings much support for Bernhard's classic view of mycorrhizal symbiosis. These views have of recent years been strongly supported by Rayner in Great Britain against the argument of Knudson that sugar and not the symbiont is the necessary factor in germination.

South Atlantic Earthquake of August 28, 1933

THIS is the subject of a most valuable paper by James T. Wilson ("The Love Waves of the South Atlantic Earthquake of 28th August, 1933" ; *Bull. Seis. Soc. Amer.*, **30**, No. 3 ; July 1940). The epicentre of the earthquake, located by Geiger's method, appeared to be lat. 58° 56′ S., long. 24° 54′ W., and the initial time 22h. 19m. 38s. U.T. using Gutenberg and Richter's tables. From a stereographic projection of the initial motion at several stations near the epicentre, it was determined that the earth movement which caused the earthquake was probably a fault striking between N. 33° W. and N. 1° E. and dipping between 63° and 76° to the east, the movement at the time of the earthquake being such that the west side moved north with respect to the east. In studying the seismograms, special reference was paid to the *G* wave portion, which was integrated by means of the mechanical integraph of Prof. L. D. Leet. From the earth motion diagrams so obtained it appears that the waves were Love waves, and that where the paths had been under the ocean almost all the energy was in the first period of the group. Furthermore, to a reasonable approximation, it was considered that on mixed paths all the dispersion took place on the continental part of the path. The amount of dispersion along the oceanic paths was much less than along the mixed paths, and from the data the author points out that there is no reason to assign different crustal structures to the different ocean basins. For example, the data from Ivigtut on an Atlantic path is practically the same as that from Honolulu on a Pacific path, and very similar to that from other stations which are on paths through the Indian Ocean basin. The structure of all the oceans appears to be characterized by having material in which shear waves have a high velocity much nearer the surface than is observed in the continental regions. The thickness of the crustal structure in continental regions, according to the author, appears to be about 30–40 km.

The Melting Range of Fats

A PHOTO-ELECTRIC method for the determination of melting points of fats by which the present lack of consistency between the results of different observers using the capillary tube method may be avoided was described by K. A. Williams at a meeting of the Society of Public Analysts and other Analytical Chemists on February 5. The fact that melting starts at a temperature below the visual melting point is confirmed by a modification of the dilatometric method which leads to reproducible and definite results for the true incipient and complete melting points. The possible use of figures for change in volume on melting and for the rate of change of density with temperature during melting is suggested as a means of characterizing fats.

Thermodynamic Properties of Propane

RECENT developments in the utilization of propane have revealed the need for more complete information upon its thermodynamic properties. The available physical and thermal data have been summarized and correlated, and some new experimental determinations of pressure-volume-temperature relationships for the liquid at low temperatures have been carried out by J. H. Burgoyne (*Proc. Roy. Soc.*, A, **176**, 280–294; 1940) at the Imperial College, London. On the basis of the information thus obtained, the entropy and enthalopy of propane have been calculated for conditions of temperature between −80° and 200° C., and at pressures of from 0·1 to 200 atmos., and are presented in a folding chart with the paper.

Covalent Radii

IN the system of covalent radii developed by Pauling and Huggins the length of a covalent bond is equated to $r_A + r_B$ where r_A and r_B are the covalent radii. For example, in the ethane, chlorine and carbon tetrachloride molecules the bond-lengths are given (in A. units) $r_{\text{C-C}} = 1{\cdot}54 = 0{\cdot}77 + 0{\cdot}77$, $r_{\text{Cl-Cl}} = 1{\cdot}98 = 0{\cdot}99 + 0{\cdot}99$, $r_{\text{C-Cl}} = 1{\cdot}76 = 0{\cdot}77 + 0{\cdot}99$. If the bonds are not single covalent bonds other sets of radii are used. Recent measurements with fluorine, hydrogen peroxide and hydrazine indicate an upward revision of the radii for fluorine, oxygen and nitrogen, and with these revised values many bond-lengths which obeyed the additivity rule with the old values are now significantly less than the sums, while for electronegative pairs (F–O, Cl–O, etc.) the bond-lengths are generally less than or equal to the radius sums, although they are greater than the lengths derived from the old radii. V. Schomaker and D. P. Stevenson (*J. Amer. Chem. Soc.*, **63**, 37; 1941) now show that new values of the normal covalent single-bond radii of hydrogen, nitrogen, oxygen and fluorine can be derived which are consistent with the bond-lengths in the hydrogen, hydrazine, hydrogen peroxide and fluorine molecules. The additivity rule for bond-lengths is shown to be no longer generally valid but it can be used with a correction for the ionic character of the bond. The latter involves the so-called electronegativity on the Pauling scale. For many carbon bonds the additivity rule gives better results than the new equation. It is concluded that bond-lengths are affected significantly by even quite small amounts of ionic character.

Asymmetry of Cosmic Radiation at High Latitudes

TWO papers on the east–west asymmetry of the cosmic radiation at high latitudes appear in the January number of the *Physical Review*. F. G. P. Seidl (**59**, 7; 1941) has measured the sea-level east–west asymmetry of unabsorbed cosmic radiation and of that radiation penetrating two thicknesses of lead, 20° from the vertical, at geomagnetic latitude 54° N., well above the 'knee' of the latitude effect. A theoretical treatment is given by T. H. Johnson (**59**, 11; 1941). The slight east–west asymmetry of the cosmic radiation is interpreted to be the result of the deflection by the earth's magnetic field of the mesotron component while the rays are losing energy by ionization in the atmosphere. Since this component contains about 20 per cent more positive than negative rays, these deflections result in an asymmetry. Orbits of rays, including those in the range of energy where rest-mass cannot be neglected, have been investigated, and the deflections without energy loss, namely, those of the primary rays described by the theory of Lemaître and Vallarta, result in a symmetrical distribution for the energy ranges concerned. The asymmetry is traced to the *difference* between the actual deflection and that of a ray which loses no energy. The 'difference' deflection δ shifts the angular distribution so that rays which, in the absence of a field, would have produced an intensity proportional to $\cos^2\zeta$ at zenith angle ζ actually produce this intensity at an angle $\zeta + \delta$. Asymmetries calculated in this way agree with the observed values, and give the correct variation of asymmetry with zenith angle and elevation.

Nature of Solar Hydrogen Vortices

THE cause of the vortex-like markings surrounding sunspots on spectroheliograms taken in the centre of the $H\alpha$ line has long been a vexed question. Two theories have been advanced to account for the patterns observed: first, that they are associated with magnetic fields produced by charged particles whirling below the solar surface; second, that they are true vortices in the hydrodynamical sense. In the January issue of the *Astrophys. J.* (**93**, 24; 1941), R. S. Richardson examines all Mount Wilson spectroheliograms taken over the period 1908–1939 in an attempt to decide which explanation is the more likely. If the particles partaking in the low-level whirl of the first hypothesis are always of the same sign, all spots with the same polarity should have the same direction of whirl; and when the general reversal of polarity occurs at sunspot minimum there should also be a reversal of direction in the vortices. In fact, however, the tendency is for clockwise whirls to appear in the southern hemisphere, counterclockwise ones in the northern hemisphere, regardless of the polarity of the underlying spot. This result, derived as it is from 141 vortices distributed over three sunspot cycles, seems likely to establish the supremacy of the hydrodynamic theory, namely, that the direction of a hydrogen vortex is determined primarily by the solar rotation, and is not connected with the polarity of the associated sunspot.

Photo-Electric Observations of 12 Lacertæ

H. E. GREEN has published (*Mon. Not. Roy. Astro. Soc.*, **101**, 1) results of observations of this star from August 30 to October 29, 1940, with the Sheepshanks Telescope, Cambridge Observatory. No detailed discussion is given as the observations are intended to be combined later with those of Prof. Fath, who carried out similar work over the same period at Lick Observatory. The comparison star was 10 Lacertæ and on some nights control observations were made on 9 Lacertæ; the fourth column of the table gives the differences (9 Lac.–10 Lac.) which should be constant. It is pointed out, however, that these control observations are likely to be much less accurate than those of the variable itself, owing to the greater distance between the stars requiring about ten times the atmospheric extinction corrections.

RADIOACTIVE INDICATORS, ENTERIC COATINGS AND INTESTINAL ABSORPTION

PROF. K. LARK-HOROVITZ AND DR. HERTA R. LENG*
PURDUE UNIVERSITY, LAFAYETTE, INDIANA

CERTAIN medicaments cannot be administered orally without either irritating the stomach tissues or becoming destroyed by the gastric juice. To avoid these effects they are given in pills with enteric coatings. Such coatings are supposed to pass the stomach undissolved and to dissolve only in the small intestines.

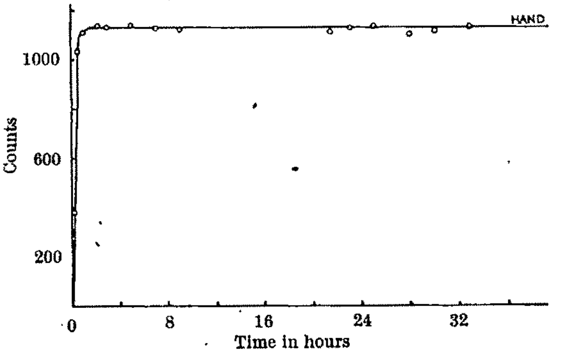

Fig. 1.

UP-TAKE OF RADIOACTIVE SODIUM AS MEASURED BY THE ACTIVITY OF THE HAND. 0·3 GM. Na^*Cl : SODIUM ABSORBED FROM STOMACH.

Since the introduction of enteric coatings by Unna in 1884, various methods have been tried to test their efficacy. In recent years X-ray radiology has been used[1]. The methods used so far do not detect cracks in the coating, which may lead to a leakage and consequently to destruction of the contents by the gastric juice.

Radioactive materials as fillings are obviously admirably suited for such tests. Any crack in the coating is detected at once by the appearance of the radioactive material in the blood-stream as measured by the activity in the hand, and the capsule itself can be easily followed on its way through the digestive tract until it is dissolved. The experimental arrangement, therefore, is the following: Ordinary gelatin capsules are filled with about 0·3 gm. of radioactive sodium chloride obtained by bombardment with 8·5 Mev. deuterons for about 2–6 μ amp.h. The initial activity of the sample is of the order of 500–700 μC. The capsule is coated with a mixture of shellac, castor-oil and alcohol following a formula of Prof. C. O. Lee of the School of Pharmacy, Purdue University. The capsule is administered orally and is followed through the digestive tract with the aid of a movable bell-type counter. Simultaneously, the activity of one hand of the patient is measured to determine the movement when the active material has reached the blood-stream.

Fig. 1 shows the activity as a function of time when the salt has been administered orally without the coating. The first sign of activity in the hand is detected a few minutes after intake; it then increases steadily to reach a constant value in about 3 hours[2].

Fig. 2A shows the location of a coated pill in the digestive tract, throughout the experiment. In this particular case, it is located for about one hour in one position in the stomach; then it moves towards the pylorus and can be located again in the small intestines. After 2½ hr. the movable counter indicates that the pill dissolves and the activity is spread over a large area. Now the activity appears also in the hand, which was, up to this time, entirely inactive.

TABLE 1.

	Total No. of Exp.	Dissolved in Intestines	Dissolved in Stomach	Unknown	Not dissolved
Handcoated pills	21	14 (66 per cent)	2 (10 per cent)	3 (14 (per cent)	2 (10 per cent)
Commercial coatings	10	5 (50 per cent)	4 (40 per cent)	1 (10 per cent)	

Fig. 2B shows the activity in the hand throughout the experiment. The first activity is observed after about 2½ hours, when the pill starts to dissolve; it reaches a maximum after about 8 hours (5½ hours

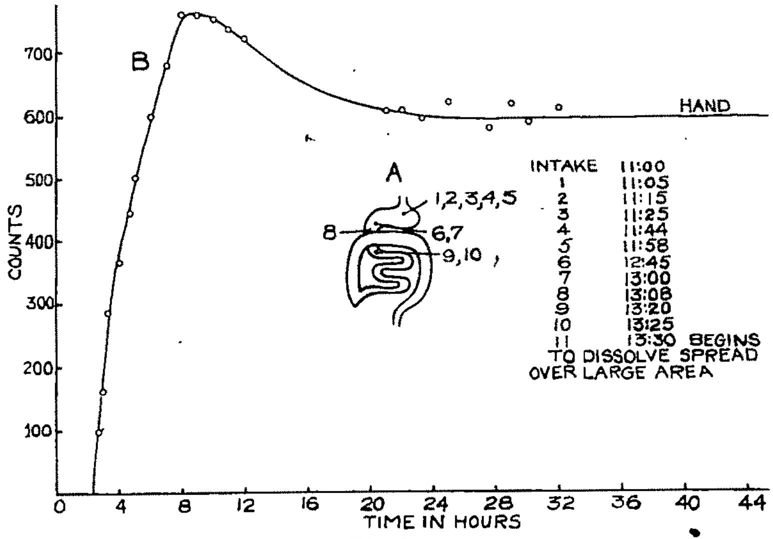

Fig. 2.

UP-TAKE OF RADIOACTIVE SODIUM FROM THE SMALL INTESTINES AS INDICATED BY THE ACTIVITY OF THE HAND. THE POINTS IN THE SCHEMATIC DRAWING *A* ARE, OF COURSE, ONLY APPROXIMATELY LOCATED. 0·3 GM. Na^*Cl IN COATED PILL, DISSOLVED IN SMALL INTESTINES AFTER 2 HR. 20 MIN.

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* Aurelia Henry Reinhardt International Fellow of the American Association of University Women.

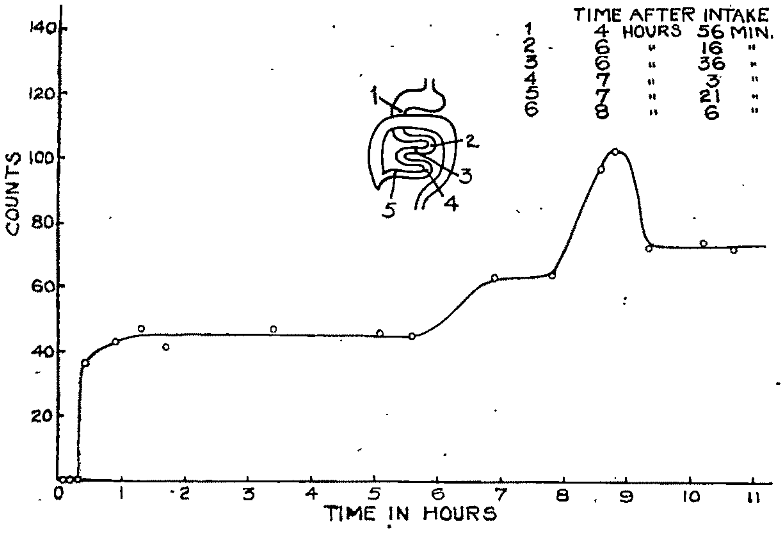

Fig: 3.

Up-take of radioactive sodium from the small intestines; the enteric coating had a leak. 0·3 gm. Na*Cl in enteric coating dissolved in small intestine after 8 hr.

after it started to dissolve) and then decreases to equilibrium value.

Fig. 3 was obtained with a pill which apparently was leaking, for an activity in the hand can be detected half an hour after intake. The pill itself could be followed for about eight hours, when it finally dissolved in the intestines. At this time the activity in the hand is raised, reaches a maximum in about one hour and falls again to a level higher than the first one, since now the total activity is distributed throughout the body.

Besides the handcoated pills, commercial coatings have been tested. In this case some 100 or 1,000 pills are coated at the same time, and the few active samples can be easily segregated with the aid of a counter.

The results in Table 1 indicate that the majority of the handmade pills dissolve in the small intestines.

In connexion with other experiments on the distribution of the sodium, potassium and chlorine ions in the body, we want to direct attention to the fact that the curve for the time-rate of absorption from the stomach is entirely different from the absorption-curve from the small intestines. In the first case the absorption reaches a level which remains constant for hours and decreases only after a large amount of the salt has been excreted. The absorption from the intestines raises the salt level temporarily and equilibrium is reached through back-diffusion, indicating that a local surplus produced by a sudden release of salt causes a real absorption through the wall of the intestines which is adjusted later by back diffusion and ionic exchange.

A detailed description of these experiments will be given elsewhere.

[1] Corley, J. T., and Lee, C. O., *J. Amer. Pharm. Assoc.* (5), **27**, 379–384 (1938).
[2] Hamilton, J. G., *Proc. Nat. Acad. Sci.*, **23**, 521 (1937).

WORK OF THE BRITISH EMPIRE CANCER CAMPAIGN

By Dr. E. Boyland

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The seventeenth annual report of the British Empire Cancer Campaign contains 280 pages as compared with 368 pages of the previous report. The total sum expended in grants in aid of research amounted to more than £40,000, as compared with £53,000 for the previous year.

Interesting advances into the possible origin of cancer have been made by examining human organs for possible carcinogenic agents. Some years ago, the Russian investigator Schabad prepared carcinogenic material from the liver of a woman dying of cancer of the stomach. Dr. des Ligneris has investigated this problem in South Africa, where cancer of the liver is common among Bantus, but not among Europeans. Extracts of livers from normal Europeans were not carcinogenic, but extracts from the livers of both cancerous and non-cancerous Bantus produced cancer in mice. Dr. I. Hieger is working on the problem in London, and has induced tumours in mice by treatment with the unsaponifiable fractions of livers from European cancerous and Bantu non-cancerous subjects. Several tumours in mice were obtained by treatment with the extract of a liver from a case of lymphosarcoma.

Normal human liver and bile contain deoxycholic acid and, as was reported in these columns (Cook, Kennaway and Kennaway, Nature, 145, 627; 1940), this acid is carcinogenic to mice when injected subcutaneously but not when painted on the skin. The carcinogenic material isolated from human livers is not likely to owe its activity to deoxycholic acid, as it is the unsaponifiable fraction which contains the active material.

Carcinogenic hydrocarbons in very low concentration are able to photosensitize Paramecia. Using this as a means of detection, Dr. J. C. Mottram has been able to show that when 3 : 4-benzpyrene is applied to mice, it accumulates in the liver and lungs. This is of interest, as it helps to explain the fact that some carcinogenic compounds induce tumours in these organs in certain strains of mice. The addition of benzpyrene to a culture of Paramecium kept in the dark increases the rate of growth, and after prolonged cultivation in the presence of the hydrocarbon many abnormal forms are produced (see also NATURE, 145, 184; 1940).

The relationship between carcinogenic action and inhibition of growth with change in chemical structure has been carefully studied and many new compounds have been synthesized. Most carcinogenic compounds inhibit growth, but 9:10-dimethylanthracene, which is a weak carcinogenic agent (and incidentally the simplest known carcinogenic hydrocarbon), does not inhibit growth. Dr. A. Haddow has tested many compounds for growth-inhibitory power, and has found that 1:2′-azonaphthalene inhibits tumour growth without being carcinogenic.

Definite inhibition of tumour growth with three types of compounds has been obtained by Dr. E. Boyland. Of the first group, of aldehydes and their possible metabolism products, citral and malonic acid were the most satisfactory; of the natural bases representing the second group, aminoethylalcohol and cadaverine gave definite results; while of the third group of aromatic diamines, 4:4′-diaminodiphenylether is the most promising. It would be of interest and value to know if some of these substances had any effect on cancer in human beings.

Dr. T. Lumsden, at the London Hospital, has tested the effect of adding normal tissue fragments on the growth of a mouse carcinoma in tissue culture. While pituitary tissue increased the rate of growth, liver fragments inhibited the growth. This latter result is in agreement with the results recently published by Brues, Subbarow and Aub in the United States, who found that the inhibitory effect of liver was in part due to aminoethylalcohol.

Prof. E. C. Dodds has continued his investigations into synthetic œstrogens, and with Dr. S. W. Stroud has studied the metabolism of these compounds in rabbits. Synthetic œstrogens appear to be more stable in the body than the naturally occurring œstrone. It was found that the œstrogenic hydrocarbon stilbene is converted into 4:4′-dihydroxy stilbene, which is much more active œstrogenically than stilbene. Several other related aromatic compounds are also converted into œstrogenic phenols in the body by an analogous change.

Dr. K. J. Bonser and Dr. J. M. Robson have examined the response of male mice of three inbred strains to synthetic œstrogens. In the *R* III strain, 60 per cent of the male mice developed mammary cancer while in two other strains (*C.B.A.* and Strong *A*) no such tumours appeared. In the Strong *A* strain the treatment caused hyperplasia of interstitial cells in the testis and the development of nodules, some of which had the histological characteristics of malignant growths. Dr. P. A. Gorer describes the post-mortem findings in three pure lines of mice. In the *C.B.A.* strain, cancer is found more frequently in males than females, owing to the high incidence of liver tumours in male mice of this line. In the Strong *A* strain, the incidence of mammary tumours is high in breeding females, particularly in animals which have frequent pregnancies but which fail to nurse their young. Mice of the *C* 57 black line are resistant to mammary cancer, but frequently develop lesions in the lymph glands, and leukoses. These differences in the types of cancer which occur in strains are possibly analogous to the differences in the occurrence of cancer in different human races.

Viruses which transmit tumours in fowls continue to be investigated in many laboratories. Dr. P. R. Peacock has compared the properties of filterable and non-filterable tumours. Tumours which can be transmitted from one animal to another by cell-free filtrates are much more resistant to the action of X-rays than tumours which cannot be transmitted in this way. Filterable tumours also remain infective after thorough mechanical disintegration which renders non-filterable tumours non-infective. These results suggest that it is unlikely that the non-filterable tumours contain a virus.

Methods for the purification of the Rous sarcoma virus have been developed by Prof. J. McIntosh at the Middlesex Hospital. By means of a modified Sharples centrifuge, considerable concentration of the virus particles was obtained. Dr. A. Pollard has analysed particles isolated in this way from the Rous sarcoma and other tumours, and also similar preparations of vaccinia virus and bacteriophage. The isolated particles from vaccinia, from the Rous sarcoma and from two non-filterable tumours are all similar in lipoid, protein and phosphorus content. Such tumour concentrates act as antigens when injected into rabbits, but in this reaction it is so far impossible to separate fowl and virus components. In other experiments it was impossible to immunize fowls against fowl tumours.

Dr. L. Hoyle, at Leeds, has examined a number of mouse tumours and extracted a lipoid antigen which does not appear to be present in normal mouse tissues. The same antigen appears to occur in several strains of tumours, but it is not present in all mouse tumours.

In the University of Sheffield Field Laboratory it has been shown that the immunization of rats to a transplantable dibenzanthracene rat sarcoma did not influence the induction of tumours by 1:2:5:6-dibenzanthracene. From this and other experiments it is concluded that no immunity to cancer can be expected using techniques based on the principles of bacterial immunity.

Dr. F. Dickens and Dr. H. Weil Malherbe have found that the metabolism of intestinal mucosa resembles that of tumour tissue. Reference is made to a discussion in NATURE (145, 512, 778; 1940) on the carbohydrate metabolism of tumours. It is now generally agreed that anærobic glycolysis and low respiratory quotient are not specific for cancer tissue.

Dr. C. E. Dukes has made a careful analysis of 1,000 cases of cancer of the rectum, a form of cancer known to be much more common in men than women. Lymphatic metastases from rectal carcinomata occur more frequently in men than in women, and these, along with the most malignant tumours, occur more often in young than elderly patients. On the other hand, the mean age of occurrence was earlier in women than in men.

The Clinical Cancer Research Committee has tabulated data from 7,872 case sheets which were received for the year 1938. Registration of new cases was suspended at the outbreak of war, but the data already available are being examined. It is very unfortunate that on some of the points there is a high percentage of "Not Stated" returns, which makes it impossible to draw definite conclusions from the figures. The suspension of registration of new cases should give opportunity to consider the results so far obtained and possibly to improve the methods of registration that will be used when the War comes to an end.

Although research in certain branches has been much reduced as a result of the War, when one considers the present situation it is gratifying to see that so much progress has been made during the year.

THE ROTHAMSTED FIELD EXPERIMENTS ON THE GROWTH OF WHEAT

By Dr. R. D. Preston
University of Leeds

It is perhaps fortunate that the approaching centenary of the Broadbalk experiment at Rothamsted has stimulated the publication of a detailed report on wheat studies carried out there, at a time when interest is growing rapidly in the question of the relative merits of farmyard and artificial manures. The Broadbalk experiment in particular has continued over a period sufficiently long to detect any progressive deterioration in the crop, resulting from the continuous use of artificial fertilizers. The present report[1] is of particular interest, since it includes not only the continuous wheat experiments themselves, but also a comparison with a variety of rotation experiments and with ordinary farming methods at a variety of stations.

The Broadbalk wheatfield was last year harvested for the ninety-seventh time in succession, and this is the third discussion which has appeared during that time. On the first occasion (1893) the first fifty years were reviewed by Lawes, the founder of Rothamsted, and his collaborator Gilbert, and on the second by A. D. Hall in 1905. Since 1919, the scope of the experiment has been widened considerably, and in particular the application of statistical methods not previously available has enabled much more information to be extracted from the existing data.

The Broadbalk field slopes downward from east to west, and is divided into strips running down the slope, each of which annually receives the same manurial treatment, different from that in other strips. There is no obvious important trend in fertility across the field; the soil is, in fact, everywhere rather poorly adapted to wheat cultivation, as evidenced by the relatively low yield (maximum 55 bushels per acre as against 60 bushels often yielded on farms and one observed yield of 96 bushels). Originally set up to disprove Liebig's theory that plants receive all their nitrogen from the air, many valuable data have been accumulated on the relative effectiveness of farmyard manure and a range of artificial fertilizers. It was early demonstrated that addition of nitrogen to the soil markedly increases the yield of grain and straw (for example, 44 lb. of nitrogen as ammonium sulphate gives an increase of 1 bushel of grain) but that minerals are also necessary. For grain production, sodium nitrate is considerably more effective than ammonium sulphate in a single dressing (43 lb. per acre) but not so much with a double dressing. For straw production sodium nitrate is always decidedly the more effective, and for both straw and grain spring application is preferable to autumn (due probably to less leaching from the soil). Levels of supply well above those in ordinary practice give greater yields. Perhaps the most important point in this connexion is that farmyard manure has only 44 per cent of the efficiency of sodium nitrate, and only 50 per cent of that of ammonium sulphate, when the artificial manures are added with complete minerals. Potassic fertilizers increase the yield both of straw and grain, an effect which is diminished by phosphate deficiency. This higher efficiency of artificial fertilizers does not appear to be offset by any progressive deterioration in the crop. During the period 1852–1918 the annual diminution in yield (eliminating random variations) was certainly lowest with farmyard manure (0·1 per cent of mean yield), but this was closely followed by the plot with complete artificials (0·26 per cent). The highest rate of deterioration was found in the plot receiving nitrogen and PO_4 without potassium, where it amounts to 1 per cent. It is interesting that on the unmanured plot, though yields fell from 20 bushels per acre to 10 in twenty years, they have not fallen lower except when weeds have become prevalent; in fact, during recent years they have risen.

This annual deterioration is attributed largely to changes in soil composition. All the plots with the exception of the farmyard manured have lost carbon and nitrogen compounds, but though the soil in the farmyard manured plots is different from that in others as regards physical properties there is no evidence that this soil is better suited to the wheat plant. There is certainly no suggestion, as the years go by, of progressive injury by rusts or by insect pests, though 'eye spot lodging' is somewhat more common than on crops grown in rotation.

Apart from this slight steady deterioration, the so-called 'annual variations' related to weather conditions, chance variations in cultivation, etc., have also been studied in detail. The main causes of such variations in yield are almost solely connected with weather factors; contrary to general belief time of sowing has no observable effect. The defect of the Rothamsted climate for wheat is that rainfall is much too high. In general it may be said that injury due to rain is least in October and greatest in or about January, when each additional inch of rain reduces the crop by one or two bushels per acre. This effect of winter rainfall is to be attributed partly to a leaching out of nitrogen (and is therefore least marked with farmyard manure), partly to excessive growth of weeds and, at Broadbalk, partly to the already heavy nature of the soil. The rainfall effect accounts for about ¼–⅓ of the total annual variation on most of the plots, though on the farmyard manured plots the effect covers about 40 per cent of the total and is the most important single factor concerned.

The chief practical difficulty in continuous wheat cultivation is the fight against weeds. The time between harvesting one crop and sowing the next is short and is usually not suited to the effective killing of weeds, and control is complicated by delayed germination of some weed seeds (2–9 years or more). The relation between weed infestation and wheat yield is not simple, but it is proved that wheat is ill fitted to stand up to the competition of weeds. Introduction of a fallow in order to eradicate weeds proved a success. The yield, which had been deteriorating, jumped immediately to the original level; an effect which is perhaps all the more striking as it lasted only one year. The main points about fallowing appear to be (1) that it enables control of weeds to be made and allows the formation of a better seed bed and soil conditions; (2) it allows an accumulation of nitrogen which may be very considerable (rising in plots with minerals only to the level of one with minerals plus 86 lb. N as ammonium sulphate); (3) it emphasizes the need for potash. Although the effect of a single fallow is so marked, a continuous wheat-fallow rotation commenced in 1856 (Hoos field) showed that the effect does not continue and a prolongation of the fallow to three years (Hoos field, 1932) or four years (Broadbalk, 1930) does not materially increase the yield. As regards the success of the old three-field system, it must be remembered that medieval fallows were never clean fallows; the land was left to natural vegetation and was grazed.

In 1930 an experiment on modern lines was begun at Rothamsted and at Woburn involving a six-course rotation of both crops and treatment. The wheat follows clover, and the yields without added manure are so good that added nitrogenous fertilizers have no effect at either station. Additional potash slightly increases the yield (Rothamsted) or, like phosphates, has no effect. In normal rotation conditions at Rothamsted (the Norfolk rotation—swedes (manured), barley, clover, wheat) begun in 1848 the addition of manure to the swedes had no effect on the wheat for the first twenty years, though afterwards the yields on unmanured land deteriorated more than on the manured. When clover failed it was replaced by beans, and both crops were found better than fallow except on unmanured land. The yields on all plots were similar, and resembled the Broadbalk continuous wheat yields with farmyard manures. In a mangold, barley, beans, wheat rotation (Saxmundham, commenced in 1899), however, the increase in yield with nitrogenous manure is almost the same as on Broadbalk, and here again the effectiveness of farmyard manure is considerably less (30 per cent) than that of sodium nitrate.

An analysis of the development and composition of the wheat plant as affected by fertilizers has produced results of no less interest. Up to a certain point increased nitrogen has no effect on the composition of the wheat plant or on its habit of growth, and this point can be carried to a higher level of nitrogen supply by giving potash and phosphates. Finally, however, a point is reached at which nitrogen is in excess; the leaves become liable to fungus attack, the crop tends to lodge, and the straw remains green for a longer time and dries slowly at harvest. The variation of composition with season is much more marked than with manuring. Milling and baking tests show no significant effect of treatment on quality, and the recent claim that wheat grown with farmyard manure is of better nutritive quality than wheat grown with artificial fertilizers is not supported by the Broadbalk samples as regards vitamin B.[1]

Continuous wheat cultivation has not found favour in England for a variety of reasons. Nevertheless, where a good outlet can be found for the straw, very frequent wheat growing has proved profitable provided the manurial system be sound; it has, in fact, been followed by a number of farmers with success. It is at least quite clear that, should continuous wheat growing be taken up in England, these experiments at Rothamsted will prove of inestimable value. On one point they are especially conclusive. No amount of manuring and no elaborate care in cultivation will ever raise a second-class wheat field into the first class.

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[1] Sir E. J. Russell and D. J. Watson, Imperial Bureau of Soil Science Technical Communication No. 40, 1940. 7*s.* 6*d.*

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, May 12

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W. 7), at 5 p.m.—Sir Charles Arden-Close, F.R.S., Mr. F. S. Richards, Mr. Arthur R. Hinks, F.R.S.: "Map Projections and Sun Compasses".

Tuesday, May 13

ROYAL SOCIETY OF ARTS (at the Institution of Electrical Engineers, Victoria Embankment, London, W.C.2), at 2.30 p.m.—Lieut.-General A. G. L. McNaughton: "Research in Canada".

ROYAL INSTITUTION OF GREAT BRITAIN (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. Alexander O. Curle: "Glimpses of 2,000 Years of Home Life: as Revealed by Excavations in the North of Scotland".*

INSTITUTE OF PHYSICS (London and Home Counties' Branch) (in the Lecture Hall of Messrs. Kodak, Ltd., Harrow), at 6 p.m.—Dr. C. Sykes: "Thermal Effects in Transformations in Metals".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING at the Leeds College of Technology—The Director of Education, Education Department, Calverley Street, Leeds 1 (May 19).

DEPUTY BOROUGH ELECTRICAL ENGINEER in the Electricity Undertaking of the Woolwich Metropolitan Borough Council—The Borough Electrical Engineer, Electric House, Powis Street, Woolwich, London, S.E.18 (May 19).

LECTURER (GRADE 2B) IN ELECTRICAL ENGINEERING—The Registrar, University, Leeds (May 19).

MANAGER OF THE WROUGHT LIGHT ALLOYS DEVELOPMENT ASSOCIATION—Mr. Eric L. Heathcote, Wrought Light Alloys Development Association, 25 Bennetts Hill, Birmingham 2 (June 7).

PROFESSOR OF MATHEMATICS—The Bursar and Deputy Registrar, University College of North Wales, Bangor (June 30).

GRADUATE TEACHER IN ENGINEERING at Kenrick Technical College—The Director of Education, Education Offices, Highfields, West Bromwich.

ASSISTANT ENGINEER FOR THE SUDAN RAILWAYS—The Controller, Sudan Government London Office, Oxford Hotel, 261 Clifton Drive South, Lytham St. Annes, Lancs. (quoting 'Assistant Engineer').

ASSISTANT ENGINEER in the Government of Zanzibar Public Works and Electricity Department—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9634).

TEACHER OF ENGINEERING SUBJECTS—The Principal, Technical School, Cole Street, Scunthorpe, Lincs.

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

National Central Library. 24th Annual Report of the Executive Committee, 1939–1940. Pp. 16. (London: National Central Library.) [244

Proceedings of the Royal Society of Edinburgh. Section B (Biology) Vol. 61, Part 1, No. 4: The Hydroid of the Medusa *Cosmetira pilosella* Forbes. By W. J. Rees. Pp. 55–58. (Edinburgh and London: Oliver and Boyd.) 6*d.* [284

Other Countries

Field Experiments on Sugar Cane in Trinidad—Annual Report for 1940. By P. E. Turner. Pp. 260. (Trinidad: Government Printer, Port-of-Spain.) [224

Department of Science and Agriculture, Jamaica. Bulletin No 25: Reprints of Miscellaneous Articles, 1938. Pp. iii+92. 6*d.* Bulletin No. 26: Banana Leaf Spot Investigations, 1: The Basis of Control. By R. Leach. Pp. ii+8. 6*d.* (Kingston: Government Printer.) [234

Proceedings of the United States National Museum. Vol. 89, No. 3098: Echinoderms from Greenland collected by Capt. Robert A. Bartlett. By Austin H. Clark. Pp. 425–434+plate 58. Vol. 89, No. 3103: *Dinotocrinus*, a New Fossil Inadunate Crinoid Genus. By Edwin Kirk. Pp. 513–518+plate 63. Vol. 89, No. 3014: A Supposed Jellyfish from the Pre-Cambrian of the Grand Canyon. By R. S. Bassler. Pp. 519–522+plate 64. (Washington, D.C.: Government Printing Office.) [284

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THE SELECT COMMITTEE OF NATIONAL EXPENDITURE

WHILE the statement on science and the national effort which Lord Hankey made in the House of Lords on April 2 (see NATURE of April 12, p. 432) of necessity adds little to an earlier statement by Lord Chatfield last year, it gives an admirable reply to certain criticisms of the use being made by the Government of our scientific man-power, and with little supplementing could well be used by the scientific worker to educate public opinion as to the part which science is playing in our war effort. It was, of course, well-nigh impossible for Lord Hankey to cover the whole field in any detail in the time at his disposal, but there are at least two respects in which from the point of view of educating public opinion his statement might perhaps have been amplified.

In his reference to the achievements of Nazi Germany in the field of science, Lord Hankey contented himself with the assertion that our men of science are at least as good as his. Without adulation of our own achievements in this respect Lord Hankey might well have pointed out that the domination of science by the State under the Nazis and the proscription of freedom of thought and investigation, apart from racial persecution and discrimination, have not only robbed Germany of many of her ablest workers, but have also made German science static. As Mr. W. Kæmpffert points out in an article "Science in the Totalitarian State"*, while science can exist in a totalitarian regime, it will be a frozen science. Science can only be a powerful social force for good when the individual worker is permitted to enjoy the fundamental freedom of democracy—to work without intellectual restraint.

Lord Hankey might well therefore have referred more explicitly to the way in which the existence of creative science and an independent scientific outlook are bound up with the existence of democracy and have pointed to the decadence of science in Nazi Germany, as Dr. C. J. T. Cronshaw did in his recent address before the Society of Dyers and Colourists. Dr. Cronshaw made the important point that Germany is fighting this war on the technical progress and skill of a generation which is running out and which in calibre, training and experience is not by great lengths matched by succeeding generations. Bias and prejudice had destroyed progress.

Reference to the work of the Select Committee of National Expenditure would also have been appropriate and useful. There are in fact few bodies which are doing more to inculcate a scientific outlook and approach to the national effort than this Committee in its admirable series of reports. Its searching but constructive criticism is designed not merely to eliminate waste but also to encourage that impartial and comprehensive view of affairs which is of the essence of the scientific spirit. Tribute to such work in Lord Hankey's statement would not have been more appropriate than deserved. The Scientific Advisory Committee takes a narrow view of its functions if it fails to recognize the assistance it is receiving both directly and indirectly from this Select Committee.

The value of the latter's work is indeed cumulative, and the very existence of such a committee is striking evidence of the inherent healthiness of the democratic system and its capacity to rectify weaknesses or abuses, given the will or driving power. The impartial but severe and searching criticism of the Sub-Committee on Air Services, in the Select Committee's Ninth Report, of the Air Ministry's practice of price contracts for the preparation and construction of aerodromes, the equally severe condemnation by the Sub-Committee on Supply Services, in the Seventh Report, of the Ministry of Works and Buildings for the absence of unified control over constructional work, and also the strictures, amounting almost to censure, on the Ministry of Transport and other Government departments in the Eighth and Tenth Reports would not be possible under a totalitarian regime, with its stifling of independent judgment and impartial analysis. Such constructive criticism is at once the strength and opportunity of democracy, provided only its leaders and institutions are capable of profiting by criticism and applying it without prejudice and with firm resolution to the remedying of the weaknesses disclosed.

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* *Foreign Affairs*, January, 1941.

These latest reports from the Select Committee, no less than the earlier reports, are in fact a searchlight on the position of and opportunity for scientific management in Great Britain. There are few factors more vital to the efficient conduct of our war-effort than scientific management, and if in his recent speech in the House of Commons Mr. Bevin did less than justice to some of the factors on the labour side which impede production, his indictment of management was fully justified in many quarters and is substantiated by evidence in these reports. There can be no place in our war-effort for management or directorates which wilfully ignore dearly purchased experience with regard to hours of work, the value of canteens and other problems in industrial psychology in which in the last twenty-five years so much work has been done by the Industrial Health Research Board, the National Institute of Industrial Psychology and by other bodies.

Many of the weaknesses which call forth the severest criticism of the Select Committee are due fundamentally to neglect of such experience or of established principles of management. It is indeed startling to find that it is still necessary to put emphasis on supervision, whether at the top to secure unified control, by the appointment of one man with the maximum authority to be in charge of each building or group of buildings in course of construction, or in the provision of skilled supervisory staff on the site. The neglect of management principles and experience thus revealed in the Seventh Report is exactly parallel with similar criticism of the Air Ministry's failure to inquire into the most economic management of labour and materials on the site, or to supply adequate supervision in aerodrome construction, and with the neglect in the exchange of technical knowledge which is the subject of comment in the same report.

The importance attached by the Sub-Committee on Air Services to the pooling of ideas and knowledge has a direct bearing on Lord Hankey's statement. It indicates at least one point in which there is some hiatus in the application of scientific and technical knowledge to the war-effort of the nation. A further point is indicated in the Sixth Report of the series, in which the Sub-Committee on Trade, Agriculture and Economic Warfare reviews the work of the Ministry of Agriculture and Fisheries.

The Sub-Committee has been impressed by the statement of witnesses that what is required to improve the standard of British farming is not so much further research work and the development of new scientific methods as the translation into practice of certain simple lessons already clearly taught by scientific study and by the experience of progressive farmers. This is largely the task of scientific exposition, to which the P E P Report on Agricultural Research in Great Britain directed particular attention in November 1938, and which was the subject of some of its most important recommendations. The great need is to find sufficient numbers of men combining knowledge with practical experience to give this instruction and advice by personal visits.

Beyond this, however, the Sub-Committee points out that action is required to ensure getting full value from the County War Committees' powers. Instructions should be issued to ensure that valuable data resulting from the Committees' experience are recorded and collated, that the experience gained and ideas developed by one Committee are made available to others, and that the fullest advantage is taken of experience gained from direct farming by the County Committees. Considerable importance is also attached to the strengthening of the Economic Intelligence Division of the Ministry, both in staff and in authority, as the chief safeguard for continuity of policy and for holding the balance between contending enthusiasts.

These recommendations, designed to facilitate all the resources of science being readily available for the solution of war-time problems, well illustrate the way in which the Select Committee's reports supplement the picture of science and the national effort given by Lord Hankey. There is, however, one further aspect, particularly stressed in this Sixth Report, to which Lord Hankey referred, in which the reports and the statement are complementary. Lord Hankey referred finally to the way in which British men of science and the scientific resources of the Empire and of the United States are building scientific equipment destined to play an ever-increasing part not merely in our war-effort but also in the period of reconstruction that must follow. The Select Committee in its Sixth Report stresses the importance, as the War proceeds, of shaping plans for post-war policy with progressive definition.

It is pointed out that the two issues—war-time food production policy and long-term agricultural policy—are closely interlocked. A complete review of the opportunities for improving the fertility of the soil would be valuable both for war and for post-war purposes, particularly a review of what can be done to improve drainage. Again, the general method for giving a sound foundation to the agricultural industry might well be the same for both the war and the post-war periods, although their detailed application might differ. The essential need for creating confidence in post-war policy as a measure for encouraging the war effort means that in agriculture especially the two must to some extent be considered together.

To this end the Report suggests that the Ministry might collect and prepare adequate material, to be issued in due course as a White Paper, so that when the appropriate time comes Parliament would have before it the basis for a comprehensive plan for maintaining, after the War, a healthy and well-balanced agriculture as an essential and permanent feature of national policy, in accordance with the Ministerial statement of November 26. It is only by continuity of policy that confidence can be created and waste avoided.

Similarly the investigation of deficiencies in the system for the distribution of vegetables which may both lead to waste and discourage production should yield results as valuable after as during the War. Again a comprehensive plan for crop production must take account not only of agricultural conditions and the need for balanced production with proper rotation of crops but also of the nutritional requirements of the country and the nature and quantity of imported food supplies which will be available. The Scientific Committee which has been set up by the Government to advise upon these problems may well lead to marked improvements in the nutrition of the nation after as well as during the War, and here again, the Select Committee observes, it may be possible to pass, as experience is gained, from the stage of tentative direction to the formulation of a definite and comprehensive plan.

These reports of the Select Committee accordingly make heartening reading in days when sterner sacrifices and more strenuous efforts are being demanded of every citizen. They show that scientific minds are resolutely probing into weaknesses and inefficiencies in our war-effort and pointing the way to eliminate them. Still more, they afford solid and renewed grounds for confidence that the sacrifices and effort demanded of us will not be in vain. It is not merely that obstacles to progress are being loosened and the way cleared for advance. In the midst of our war-effort there are slowly but progressively emerging the lines of policy and the plans which will shape a new era in which science may prove itself a growing social force for good in the democracies it has helped to victory.

THE FEEDING OF LIVESTOCK

The Principles and Practice of Feeding Farm Animals

By E. T. Halnan and Frank H. Garner. Pp. x+359+8 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1940.) 15*s*. net.

THE stress of totalitarian war has quickly revealed the fundamental instability of systems of livestock husbandry which are largely dependent upon supplies of imported feeding-stuffs. In an industrialized State, concerned to maintain a large export trade and with a large investment of capital in the less-developed regions of the world, it is inevitable that the national agricultural economy should provide for a considerable absorption of imported grain, oil-seeds and other primary produce. If this absorption has developed beyond the limits of security for war conditions, the blame, if blame there be, cannot be placed upon the farmer, since he has little option but to adjust his system of husbandry to the economic environment created by national and international policies.

The direct responsibility which he must accept is that of avoiding waste in his use of feeding-stuffs, especially when, as now, both private and national interest make this imperatively necessary. That the avoidance of waste is to his own material interest at all times is plain, but the precept is nevertheless all too often honoured 'in the breach' on the farm, partly through the practical impossibility of maintaining a precise control of supplies, and partly through the natural repugnance of the good stockman towards any stinting of food to his charges below the full limit of their appetites.

That the physiological economy of utilization of food tends to fall long before the extreme limits of appetite are reached has been abundantly demonstrated, and more often than not the same is true of the financial economy of the process. In so far, therefore, as the supply of food to the animal is based upon economic considerations the need for controlled feeding is obvious, and much of the effort of the nutrition investigator engaged upon agricultural problems has been directed towards ascertaining for the different classes of livestock the levels of food-supply at which the maintenance requirements and productive activities of the animal can be covered with minimal waste of food. Such 'feeding standards' have been tabulated from the earliest days of agricultural nutrition science, but it is only within the present century that they have attained a sufficient degree of precision and conformity with farm experience to secure the confidence of the farmer and his practical advisers. Towards this end the spread of technical education among farmers through the improved training of new recruits and other forms of educational effort has also made a powerful contribution. But for this it would have been impossible to apply to the industry a national system of rationing of food supplies so closely adapted to its varying needs as that now in operation.

Although much of the newer knowledge of nutrition has little practical import for the greater part of our animal husbandry, it is none the less necessary for the farmer and student to be adequately informed as to the full range of the fundamental requirements of the animal. At one extreme where natural foods and outdoor environment enter largely into the system of management, the stockman will have little concern except to ensure adequate supplies of nutritive energy and of protein, and will have little anxiety as to the concurrent supply of vitamins and essential mineral elements. Where, on the other hand, the system is highly 'intensive' and artificial in character, as in the case of a large part of our pig and poultry husbandry, and some part of our dairy husbandry, the full range of nutritional knowledge must be taken into practical account.

Although the British agricultural research organization has made a large and valuable contribution to this knowledge it has produced as yet only a very modest output of literature designed to meet the needs of the farmer and agricultural student. So far as the mere exposition of fundamental principles and the advance of scientific knowledge is concerned these needs are adequately met by American and Continental literature; but the discussion of their application in British farm practice can obviously only be dealt with effectively by authors who are familiar with the systems and environmental conditions under which livestock management is conducted in Britain. The required amalgamation of science with practice is perhaps most effectively met by collaboration of nutrition scientist and agriculturist, supplied most appropriately in the present case from the personnel of the Cambridge School of Agriculture, which for the past thirty years has been a leading centre of agricultural nutrition research. One might have expected the Cambridge authors to have been primarily concerned to cater for the needs of students; but in terms of printed pages and detail of exposition this present volume is more largely a practical manual than a scientific text-book. In the introductory section dealing with the principles of nutrition a high degree of compression has been exercised and not a single reference to original literature is cited. It will not satisfy the student and will probably be found rather difficult reading by the farmer not well versed in science. What is dealt with most fully and admirably throughout the whole work is the modern technique of control of rations to secure efficiency with economy. On this aspect of the subject it gives the best exposition yet available and will form the standard work of reference for student and farmer alike. One could only wish that the plain application of science had not been so largely obscured by the inclusion of a mass of practical detail that requires no new exposition.

In their attempt to cater for both student and farmer in one volume the authors have certainly come near to success, except for the needs of the more advanced student. Theirs is not the text-book for which degree and diploma students have long been waiting; but it may be warmly recommended to the larger farming public which is more concerned to know how to apply modern methods than to understand the scientific basis upon which they rest.

Charles Crowther.

THE GENESIS OF PRINTING INKS

Printing Inks

Their Chemistry and Technology. By Carleton Ellis. Pp. 560. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1940.) 42*s*. net.

THE printing-press has without a doubt been one of the greatest factors in the progress of man. The name of the supposed inventor of printing from movable type is known to all informed people, but it is now fashionable for scholars of history to dispute the claim of Gutenberg and give the credit to one Coster of Haarlem. Apparently the most convincing German records discovered at Mainz in 1740 are held to be forgeries. The British at least can still pay tribute to Caxton for his share in bringing the printing-press to our shores.

The press needs paper and ink besides type to produce a book, and it is a proper question to ask who invented ink. All we know is that the forerunners of ink and paper were not developed prior to 4000–2000 B.C. simply because there was no need for them. Writings were few, slaves were many; characters were incised in stone tablets or marked on clay which was later baked in kilns.

The Egyptians used dyes to colour the engraved markings to make them more conspicuous—a suspension of coloured charcoal and gums in water. As trade expanded there was need for a more portable and convenient writing material and papyrus sheets came into use as long ago perhaps as 2500 B.C. Later papyrus met with competition from parchment and vellum, but not until the third or fourth century A.D. This delay may have been because leather was in demand for many other uses.

The earliest inks used on papyrus consisted of soot or some other finely divided form of carbon suspended in a varnish containing a drying oil; for red inks iron oxide was used. Such pigments have retained their colour over a span of almost five thousand years. Mention is first made of inks which penetrated the body of the sheet rendering erasure much more difficult about A.D. 50. Pliny apparently used a suspension of lamp black and copper sulphate in water.

Indian ink, which of course has nothing to do with India, was developed by the Chinese at the beginning of the third century. The chief ingredient was lampblack, pounded through fine silk to reduce its size; this was made into a paste with glue, water, the whites of several eggs, cinnabar and musk. After prolonged grinding in a mortar the ink was cast in sticks and was sold and used in this form until the reservoir pen ousted ink from the writing-table. Kipling records that he used it at Bateman's in preference to any other ink; my father always had a stick on his table and a small round white dish in which to rub it down in water for use on special occasions. The art of ink-making became very widespread and important in China, and Indian ink was long recognized in Europe as the finest quality of black.

The quill pen which permitted the use of a more liquid ink was the last invention of note before the dark ages following the fall of Rome. For five hundred years or longer progress was left to the monks. Gall inks came to Europe from Arabia about A.D. 1100 and gained increasing popularity in the monasteries. All this time there was no call for the multiplication of documents: such copies as were required were made by the monks in their abundant leisure, but by 1400 the invention of printing was at hand. Carved wood blocks were cut for the illustration of the text of a scribe who filled in the written matter by hand, and it was not a far cry to place the text on the same block. The next step was to develop the art of printing from movable type.

The earliest printing ink contained sulphate of iron in combination with vegetable astringent matter and with very little carbon. Before long inks made of linseed oil and lampblack, applied to the surface of the type with inked pads, were used. About 1823 an ink formula consisted of linseed oil, rosin and hard soap added so that the ink would leave the type easily. To-day in printing inks the craftsman ink-mixer has given part-place to the man of science.

This book takes 450 closely written and printed pages to tell us all about vehicles and pigments, driers and modifiers. There are also very many special types of inks which may be employed on a great variety of materials often at high speeds of printing. There are many ink problems in the production of a newspaper at high speed on paper of poor quality—a discussion of these takes up many pages. In short, it is possible to write an erudite and practical monograph on the subject of printing inks alone. The name of Carleton Ellis is a guarantee that the work is accurate, thorough and comprehensive. He has enriched so many fields of applied chemistry by his writings and it is a melancholy thought that this must be the last, for he recently died. The printed book, magazine or newspaper is the commonest thing in the land; to be bought for a copper or two, glanced at and thrown away. Few readers spare a thought to the lives and ingenuity devoted to giving them type, ink and paper; least of all do they realize how much applied science, peaceful science is responsible for their merits and cheapness. If NATURE had to be produced by the monks and the few copies were handed from one to another, there would be perhaps more appreciation of its contents, but its missionary value would be less.

Carleton Ellis has done good service to the end of his useful life by producing this monograph.

E. F. ARMSTRONG.

SOIL FERTILITY AND NATIONAL HEALTH

An Agricultural Testament

By Sir Albert Howard. Pp. xvi + 254 + 13 plates. (London, New York and Toronto: Oxford University Press, 1940.) 15*s*. net.

THE strong criticisms of the agricultural practices in many countries at the present day, and of the aims and technique of modern agricultural research made in this book, are based upon the author's work and experience during a period of forty years in the West Indies, India, and Great Britain. It is with the process of manufacturing compost evolved in the Institute of Plant Industry, Indore, Central India, between the years 1924 and 1931, that the name of Howard is more particularly associated in agricultural circles.

The key of the arguments used in these criticisms is stated in the following quotation from the chapter on the nature of soil fertility: "The wheel of life is made up of two processes—growth and decay. The one is the counterpart of the other. . . . Humus is . . . an essential material for the soil if the first phase of the life cycle is to function. . . . Its presence in the soil is an essential condition for the proper functioning of the second contact between soil and plant—the mycorrhizal relationship".

The methods adopted to maintain soil fertility in China, and under the old mixed farming systems of a large part of Europe, are quoted as examples of successful stabilization of agriculture without loss of fertility, in contrast to the "soil mining" methods characteristic of "Western agriculture", to which the United States Soil Conservation Service is now devoting so much of its attention.

The book as a whole and the chapter on present-day agricultural research in particular contain a great deal of criticism of the "NPK mentality" which originated with Liebig in 1840, and was revived, following a temporary lull, with great vigour in the years following the War of 1914–18, when the factories then engaged in the fixation of atmospheric nitrogen for the manufacture of explosives had to find a new market.

The agricultural literature during this last period is full of the results of innumerable field experiments "bewildering in their volume, their diversity, and often in the conclusions to be drawn from them. By a judicious selection of this material, it is possible to prove or disprove anything or everything". Mathematics was introduced to give a greater measure of reliability, field plots were replicated and randomized, and the figures subjected to a rigid statistical scrutiny. During this "age of the manure bag", there has occurred an increasing loss of soil fertility, an increase in crop and animal diseases, a decrease in the standards of human health and nutrition, and the apparent futility of the work of plant breeders, who produce new varieties with an increased yield which can be obtained only at the expense of more soil capital.

The present situation must be saved by the community as a whole, if a *C*3 population is not to be created, "fed on improperly grown food . . . bolstered up by an expensive system of patent medicines, panel doctors, dispensaries, hospitals, and convalescent homes". In the United States alone it is estimated that no less than £700,000,000 a year is spent on medical care.

Much of the book is devoted to a description of the actual technique involved in the Indore process, and to its practical application and development. The crops considered are tropical or subtropical in nature, but there are also interesting comments on grassland management, orchard management and similar subjects.

It is probable that many of the criticisms and provocative statements made in this book will be answered to some extent by the major trend in world agriculture towards the increased use in many countries of grasses and legumes, and particularly of the temporary ley, in farming rotations. In this way, fertility, structure and organic matter content of the soils, whether formerly in permanent grassland or mono-cultivation, will be greatly improved in a healthy way, without the need for excessive use of the chemical dopes which, according to the author, are poisoning the nutrition of crop plants, domestic animals and human beings.

The other important method of returning organic matter to the soil, namely, the practice of green manuring, is approved of, if the crops grown for this purpose are cut and used to provide material for composting, leaving only the root system to decay in the ground and thereby considerably reducing the burden on the soil.

R. O. WHYTE.

COLONIAL ADMINISTRATION

Democratise the Empire
A Policy for Colonial Change. By W. M. Macmillan. (The Democratic Order, No. 6.) Pp. 64. (London: Kegan Paul and Co., Ltd., 1941.) 1s. net.

ON the first page of this arresting, and indeed, challenging pamphlet, the author says, "on the face of it, Empire, the government of weaker peoples by a power outside themselves, is the very antithesis of the Democracy for which we stand". The truth, of course, is that in a too rapid development towards independence there is great danger lest a country, lately brought within the orbit of modern civilization, be controlled by the well-educated few who will not be subject to the checks of an informed and articulate population. In such checks lies the real strength of a democratic constitution.

Prof. Macmillan recognizes this, but he maintains that the pace has been too slow and that British Colonial policy has suffered from *laisser-faire*, particularly in the economic sphere, one on which he is very competent to speak and on which he has many interesting things to say. He praises the 'tripartite Co-operation' of the cotton-growing enterprise in the Sudan, whereby the Government met the cost of a large-scale irrigation scheme, the Sudan Plantations Syndicate provides expert management and the peasants receive a fixed proportion of the price of the cotton when sold. This principle, he says, might be applied to mining, public utility services, plantations, and so on. Some of the profits might be returned to the people in the shape of improved welfare services.

There are many who would also like to see experiments made in 'co-operation' (in the technical sense) especially among the inhabitants of the rural areas, combined with a scheme for the education and development of the people based on their indigenous culture and traditional way of life. Such experiments might well follow the suggestions contained in a memorandum emanating from the Colonial Office Advisory Committee and entitled "The Education of African Communities".

It is impossible in a short article to discuss the many aspects of the Colonial problem upon which Prof. Macmillan touches. This small book is packed with interesting and suggestive comments.

The main theme, however, is political structure. He is somewhat critical of 'Indirect Rule', which is now an accepted principle of government in some of our Colonies. He recognizes its value as a form of local government, provided that it is not considered "as the last word in the Government of any people". In due course the people will rightly demand control of the non-native supreme authority, and he asks what machinery we can provide but representative institutions.

The real justification for 'Indirect Rule' is that it represents an important educational stage. In its present form it is a means and not an end in itself. Moreover, 'Indirect Rule', adopted in many African Colonies, cannot be applied to such Colonies as the West Indies, where tribal tradition and authority do not exist.

If 'Indirect Rule' is to be not merely a temporary expedient but also to supply the basis of future Government, there must be clear vision of the end in view and the means for attaining it. It is for the British Government to see that the successive stages in each Colony are reached as soon as local conditions make such advance possible. That the British Government is prepared to shoulder this responsibility is indicated by the steps already taken to make a survey in each area of the political framework, economic possibilities and the various human problems involved, as a first step towards formulating a progressive policy. The immediate goal appears to be gradually to develop, from indigenous institutions, forms of local government embracing far larger areas and sections of the population than those from which they have sprung, and federated under a central council which derives its authority from them. The people themselves will eventually have to decide in the light of experience gained during this educational period, to what extent modifications suggested by European forms of democracy may be desirable.

It would be out of place here to mention international problems involved in our own Colonial policy, but there is one outstanding difficulty within our boundaries which must be faced. It is that of reconciling the natural aspirations of the African population with the claims of Europeans in areas of white settlement. The problem is one of immense difficulty, but if handled firmly and handled quickly, there is no reason why it should prove to be insoluble.

E. R. J. HUSSEY.

INDUSTRIAL PSYCHOLOGY FOR FOREMEN

The New Techniques for Supervisors and Foremen
By Prof. Albert Walton. Pp. vi+233. (New York and London : McGraw-Hill Book Co., Inc., 1940.) 17*s.* 6*d.*

THIS is a remarkable book written by an author of remarkable experience. "The new techniques" which it describes, in elementary fashion, are those of industrial psychology. "Management," he says, "faced with the absolute necessity of adopting the new techniques" crudely employed by the early efficiency engineers in the United States, "yet finding that their introduction was always the signal for labor troubles, finally recognized that the problem was, in its essence, a psychological one. They turned to the university psychologists and asked them what could be done about it. Bred in the cloistered peace and quiet of their campus laboratories, these psychologists were not of much assistance. They had no experience in the workaday world, and most of them were not inclined to venture into it to attack the monumental problem which they had been asked to solve. Here and there a bolder spirit was found who could see not only the tremendous interest which might be aroused by work in the field but the vital necessity for finding a solution. . . . A few pioneers took up the work and soon found they had entered a rich field in resources and awaiting only careful research to yield a wealth of practical values not only to the industry but to general psychology itself" (pp. 104–5).

Prof. Walton was not one of these academic psychologists. He was more than forty-five years old when he entered the University of Washington in Seattle as an undergraduate student in psychology. He had, when a youth, graduated at Cornell as a mechanical engineer, after which he was engaged for twenty-five years, he tells us, "in the field of industrial engineering, part of the time with such organisations as Westinghouse and General Electric, . . . and part of the time as a consulting industrial engineer with my own office and private practice" (p. 1). He regarded his new career of a psychologist as one "in which age would be no barrier but rather an advantage". From Seattle, after taking his master's degree, Prof. Walton proceeded to Stanford University where he taught classes in psychology, took his doctor's degree, and then served as instructor in psychology, until he accepted his present post of assistant professor at the Pennsylvania State College. Here he has been teaching industrial psychology in "foreman training classes in the various industrial plants around Philadelphia and the territory within a hundred miles of the city" (p. 3). Thus he "came into the field of psychology after a quarter of a century in the active world of industry, looking", as he says, "for something usable, something that I could apply to my own situation" (p. 3). The present volume virtually contains what was covered by this course in industrial psychology for foremen, and concludes with an appendix giving notes of supplementary discussions attended by those who had already been through the earlier course.

There are many details in this book with which the 'pure' psychologist may not agree. He will object to the definition of psychology as "the study of the mind, which is what we think with" (p. 8) ; but the author fully realizes the important part played by the feelings, drives, motives and by what he calls "intents". He will object to the statement—"The only way we know anything about the mind is by what the body does" (p. 11) ; but the author is clearly far from being an extreme 'behaviourist', for although he urges that "interviewing is not a satisfactory way of securing an estimate of a man's abilities" (p. 19), possessing, as it does, the weakness of allother 'subjective' methods of investigation, he concedes later that "in no test program with which we are familiar has it been proposed to do away with the interview entirely and to place sole responsibility on tests. The test is to serve as an aid to the personnel department and to the supervisor" (p. 66). The psychologist may also cavil at the statement that instinctive reactions "and a few reflexes are all the child has at the outset. All else is learned" (p. 26), and at the exaggerated distinction drawn between what is innate and what is acquired. But it becomes clear that this and many other criticisms arise mainly from the need for extreme simplicity of initial statement, having regard to the previous education of those whom the author is addressing.

It is from this point of view that the book should be judged ; and no fair critic can read it without admiration and appreciation of its almost perfect fitness for its purpose. It should be read by every progressive departmental manager and intelligent foreman in English-speaking countries.

C. S. MYERS.

PHARMACOLOGY WITH GRACE

Pharmacology
By Prof. J. H. Gaddum.. (Oxford Medical Publications.) Pp. xv+408. (London: Oxford University Press, 1940.) 17*s.* 6*d.* net.

It is characteristic of the author of this book that he should call it by the unencumbered title "Pharmacology"; not "An introduction to" or "A Text-book of" or "Essentials of" or any other of the common attempts to avoid a simple statement of what a book contains.

This directness is evident throughout the book, which is noteworthy in the first place for the excellence of its literary style. Quiller Couch in "The Art of Writing" proposes that writing should be appropriate, accurate, perspicuous and persuasive, and has explained those terms in a way which makes it clear that if there is one form of training which should make better writers than another, it is scientific training. Certainly those engaged in scientific research have a constant stimulus to be accurate and perspicuous; if they cannot make their deductions clear to others, they do not understand them themselves. The processes of Nature which they study should make them modest and their language therefore appropriate, and their repeated failures, by developing their humour, should give them persuasiveness or charm.

It is impossible to refrain from quoting odd sentences from different parts of the book which indicate how pleasant it is to read. Speaking of the use of tetrachlorethylene for the treatment of hookworm disease, Gaddum says: "Many thousands of men and women have been treated with it; there have been no fatalities among the patients, but unfortunately no one knows how many fatalities there have been among the worms." In discussing sulphanilamide, used for its lethal action on streptococci and other bacteria, he gives a list of twenty-three names under which this one substance is sold, and adds: "There is no point in memorizing these names, which are given as an awful example of the ingenuity of manufacturers."

Perhaps the best one is the explanation of frequency distributions, which begins: "A certain rich man had 64 friends and gave each of them 100 marbles." It may be explained that the friends then toss coins, the loser forfeiting a marble to the winner, and continue this process six times, to furnish a diagram showing the distribution of the marbles among friends who toss fairly.

Pharmacological teaching has slowly progressed from materia medica and doses to the action of substances in the body. The teaching is still given in many schools by those who have little acquaintance with laboratory work, so that students remain ignorant of the methods which are introducing so many new remedies into medicine, and are also unable to form any opinion of the justice of the claims made by advertising manufacturers. The distinctive feature of Prof. Gaddum's book is that it attempts to fill this gap and to give instruction in the methods actually used by experimental workers. It stresses the steps which should precede the introduction of new preparations into the hospital: "In 1937, for example, diethylene glycol was introduced as a solvent for sulphanilamide, and 71 people were killed. This accident could have been avoided if a few simple toxicity tests had been carried out." Evidently, this book is suited not only to medical students and doctors, but also to chemists engaged in the manufacture of new remedies. If they are to be successful they must understand what the pharmacologist can do, and how much labour is involved in doing it.

Special mention must be made of the chapter on general pharmacology at the end of the book. It contains a very clear exposition of methods of calculating experimental errors, which is short and valuable for those with no inborn or acquired mathematical appetite.

Many features of the general arrangement of the book are original and seem an improvement on the usual arrangements. In the preface it is stated that "the information sought by examiners has been included as completely as possible". No doubt opinions will differ whether sufficient attention has been paid to this or that section, but it was certainly right to make the book no longer than it is. Since it would not be fitting to conclude without some positive criticism, it may be suggested that the view that insulin is concerned in the combustion of dextrose has been abandoned many years ago; the diabetic needs less insulin when he plays tennis.

Let us, however, congratulate the author (and the publisher) on this attractive, well-illustrated book.

J. Harold Burn.

THE PHYSICS OF AIR RAIDS*

BY PROF. J. D. BERNAL, F.R.S.

A GREAT deal of the terrifying effect of bombs has been due to our lack of knowledge of the processes that take place. It is naturally difficult to study events which take place with the rapidity and violence of explosions, but it is not impossible, and thanks to the work of a large number of physicists in many countries before the War, and particularly in Great Britain during the War in the laboratories of the Department of Scientific and Industrial Research, we may say that the main features of the physical processes involved in explosions are becoming well understood. Naturally it is impossible to give here more than the broadest outlines of our present knowledge, both on account of its intricate nature and even more because of the requirements of secrecy.

Most of the effects of explosives on materials can be best understood by considering the explosive to generate a wave of extremely high intensity travelling through the body at a very high speed. Normally, mechanical disturbances travel in materials at the speed of sound, a speed which is determined by the square root of the ratio of the density of the body to its elasticity. Where the density is large and the elasticity small, waves travel slowly, and vice versa, the limits being between about 500 ft. a second in carbon tetrachloride vapour to 17,000 ft. a second in steel. For the high pressures which exist near explosions, much greater velocities occur. This is because the elasticity of bodies depends on the pressure; the interiors of atoms are more rigid than their outer surfaces. On intense compression a high elasticity and therefore a more rapid wave is produced. This is, of course, much more marked in gases than in solids and liquids. The velocity of sound in water may change from 6,000 to 12,000 ft. a second in the neighbourhood of an explosion, but that in air will change from 1,000 to about 20,000 ft. a second.

There is also a change in the character of the wave. High-pressure waves have not the smooth wave form of ordinary sound waves. Instead, the pressure in front of the wave rises immediately to its highest value and then falls off gradually and is followed by a phase of less than atmospheric pressure or suction (Fig. 1). The generation of this steep-fronted or shock wave is very similar to that of the waves which break on the sea-shore; the high-pressure phase of the disturbance, always travelling faster than the low-pressure phase, gets to the front, just as the top of the wave on the sea-shore, being held back less than the base by the friction of the sand, moves forward and ultimately breaks the wave. The shock wave is always breaking, as the free front portion is losing energy more rapidly than that behind and consequently, quite apart from the spreading of the wave, it is always dying down, most quickly, of course, nearest the explosion, and ultimately it degenerates into an ordinary sound wave.

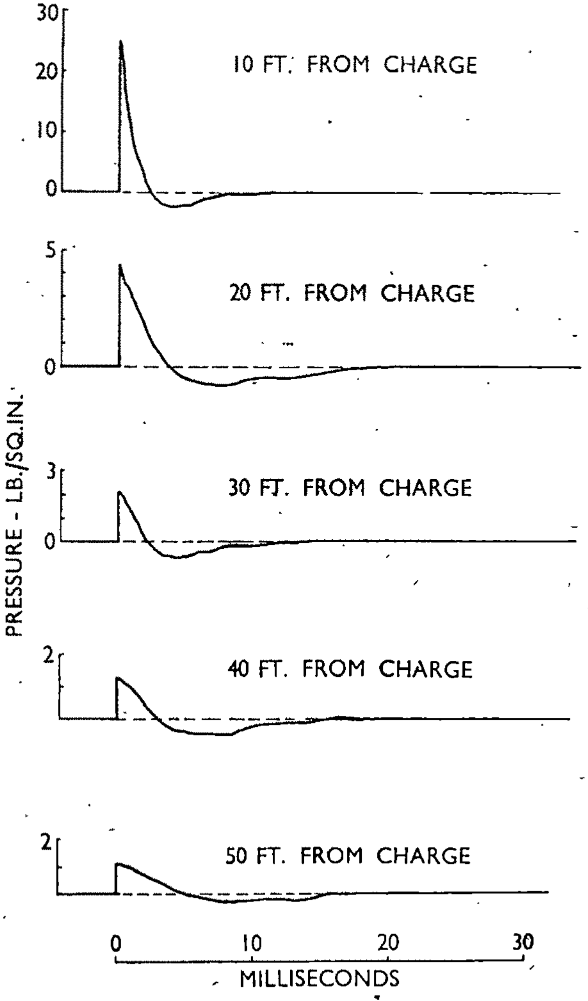

Fig. 1.

PRESSURE-TIME CURVES OF BLAST FROM 2-LB. CHARGE OF BLASTING POWDER.

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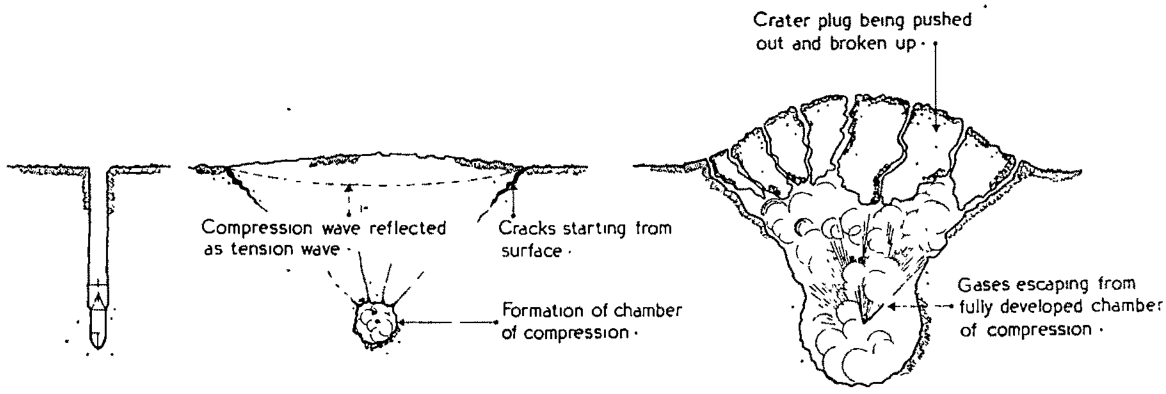
* From a special afternoon lecture delivered at the Royal Institution on December 3.

The shock wave in air is what is usually known as blast and is responsible for most of the slighter effects of air raids, such as breaking of windows. The pressures needed to do this are not very considerable. Pressure peak values of 1–10 lb. per square inch, or less than an extra atmosphere, are able to break most windows, but peak pressures have to rise to about 100 lb. per square inch, or 6 atmospheres, before human beings are endangered, and this only occurs very close to explosions, so that in fact very few people are directly injured by blast. The shock wave, however, is not only an increase in pressure. Immediately behind the wave front the air is moving forward and there is an initial forward push followed by a backward pull. This, of course, can move loose objects about and throw people down or throw other things on top of them. Most injuries due to blast are only secondary in this sense and usually not very serious.


Crater plug being pushed out and broken up
Compression wave reflected as tension wave
Cracks starting from surface
Formation of chamber of compression
Gases escaping from fully developed chamber of compression

Ⓐ BEFORE EXPLOSION · Ⓑ AFTER 0·002 secs · Ⓒ AFTER 0·1 secs ·

Fig. 2.

The freakish effects of blast on windows are not only due to the great variety of windows used. The shock wave behaves like any other wave in that it is reflected with more or less absorption from everything that it strikes. In streets, particularly with tall houses, this reflexion is almost complete. Consequently, a bomb exploding in a street sets up a series of reflected waves which at a considerable distance are like a periodic disturbance. If it happens that a window has a similar natural frequency, this periodic disturbance may break it by resonance. Consequently, isolated windows are often found broken at great distances from bombs.

Another so-called freak effect is due to the fact that a shock wave in a narrow street is reflected in a different way from the opening at the top of the street. A compression wave travelling in an open-ended pipe produces, when it reaches the end, a reflected suction wave, as the air having been driven out of the pipe a temporary vacuum is left behind. When this happens in a street, the reflected suction wave may be much stronger than the original suction wave of the bomb and may produce violent effects on windows and doors in lower stories, drawing them out towards the street.

A shock wave behaves in a characteristic way towards limited obstacles. Ordinary sound waves throw shadows only from the largest obstacles, such as hills or high buildings, because their wave-length is of the order of 10–100 ft. A shock wave, strictly speaking, has no single wave-length but a number of wave-lengths. The sharp high-pressure part has a very small wave-length and the tail suction part has a very long one. Consequently a shock wave passing through an aperture or round an obstacle is changed in character. Roughly speaking, the pressure part goes straight and casts shadows, whereas the suction part travels round corners without any difficulty. Thus behind a wall the pressure part of the wave may be cut down to about a tenth without making any difference to the suction part. This is very useful, as it has been shown that it is the pressure part of the wave that is responsible for most physiological damage. To have even a small garden wall between oneself and the bomb is practically to be secure from direct effects of blast. On the other hand, an open doorway is a danger and the necessity of putting baffles in front of Anderson shelter entrances applies to the blast as much as it does to the splinters.

Much of the terror attached to bombs has been due to stories of people being killed at great distances, without any physical injuries, by the mysterious effect of blast. Investigation has shown that the effect of the blast wave is that of a simple blow on the body. Most of the body is solid; the only empty parts are the lungs, and the effect of blast is essentially to bruise the lungs through the chest wall. This is effected only by the pressure part of the wave; the suction has no effect. Fortunately lungs will stand a great deal of bruising without permanent injury, and though quite a number of blast cases have occurred, most of them have recovered. Now that the nature of the injury is known, they can be treated as non-infected pneumonias, which, in practice, means only rest in bed.

Apart from blast, the main damage produced by bombs is due to splinters and earth shock. When a bomb bursts, the case first swells and then breaks up in a way very similar to the bursting of a gas cylinder under excess pressure. Failure takes place in tension along planes at 45° to the bomb surface, yielding angular fragments which are driven forward by the expanding gases. They therefore have very high velocities up to about 4,000 ft. a second and consequently have very considerable penetration into materials. The fragments are of all sizes, ranging from lumps of 40 lb. or more down to the most minute dust. As a result of experiments largely carried out since the War began, we are beginning to understand the mechanism of penetration of these fragments and the best ways of stopping them. Luckily the cheapest materials are, in fact, very effective. Three feet of sandbags have stopped any small fragment that has occurred in this War, and 13½ in. of brick will stop all but the biggest.

Only a proportion of bombs actually explode on the surface, usually on streets or concrete slabs; the great majority penetrate either into buildings or into the ground. The characteristic crater is that produced by a bomb exploding about 10–20 ft., according to size, underground. The damage done by such bombs is not due either to blast or splinters, but to the effect of the explosion on the earth. When a bomb explodes in a dense medium, such as soil, it produces a shock wave travelling at velocities which depend on the nature of the soil. As all soils get more elastic as they go deeper, the shock wave travels in a complicated way; it is reflected from the lower levels, and at distances of more than 100 ft. has already become a complex train of waves very similar to those found in earthquakes. Such waves can shake down buildings in a somewhat capricious way, depending on the natural frequencies of the building in relation to that of the waves, but generally speaking only old or badly built buildings are affected.

The most serious effects of ground shock are those nearer to the explosion, and are not due to the shock wave but to the bodily movement of the earth near the bomb. After explosion the explosive gases push the earth aside, forming an initial sphere of expansion. The displaced earth is moved outwards and quite considerable displacements occur. The displacement is partly elastic and partly plastic. The earth may be moved some inches and come back to within half an inch of where it started. This earth movement is, of course, mostly dangerous to underground structures. It is not so much an instantaneous blow as a steady pressure exerted for a time of the order of 0·1 sec. It is least effective on structures which can yield to such pressures without breaking. One of the main advantages of the Anderson shelter is its flexible character. This earth movement is usually responsible for the breaking of gas and water mains by bombs.

When the shock wave from an underground bomb reaches the surface, it is reflected as a tension wave, and if it is strong enough the ground cracks and a conical 'scab' is formed which is projected upwards, usually breaking up and leaving the characteristic crater behind. The observed crater, of course, is always complicated by the presence of material which has been thrown out and fallen back into it. The true crater is usually almost twice as deep. If the bomb is too deep, the breaking of the surface does not occur; it is simply heaved up and drops back more or less into place. This is called a 'camouflet'. Such camouflets are usually of little importance, except that they may be mistaken for unexploded bombs.

When a bomb strikes a building the effects are naturally complex, but they depend on relatively few principles. When a bomb explodes in a house its primary effect is to cause a blast wave which, meeting walls, blows them out. The effect is greater than blast in the open because the waves reflected from other walls add their effect to that of the initial blast, producing a more prolonged pressure and consequently a greater outward momentum. Except in very large halls or sheds, this blast pressure is sufficient to break the wall and project a considerable portion of it clear of the building. What happens afterwards depends on the type of the building. In favourable cases the only result is to form a hole in one or more external walls, the remaining part of the building holding together. More often the damage to the walls causes partial or complete collapse of the building. With steel-framed or reinforced concrete buildings the frame prevents the falling of the upper part of the building and holds up the comparatively small load produced by the immediate effects of the explosion.

This outline of some physical aspects of air-raid damage shows that we have a quantitative picture of the dangers of raids; this is the first step in providing rational means of minimizing them.

REGIONAL AGRICULTURAL LABORATORIES IN THE UNITED STATES

By Dr. R. O. Whyte

Imperial Bureau of Pastures and Forage Crops

DURING the past five or six years, a major development has been taking place in agricultural research in the United States, which should have a considerable effect on the rate of progress to be expected in several important problems, and on the number and scope of scientific papers published.

This development may be said to have originated officially with the signing of the Bankhead-Jones Act by President Roosevelt on June 29, 1935. This Act provided for substantially increased Federal aid for fundamental agricultural research, agricultural extension and land-grant college instruction.

The appropriations granted by Congress were 980,000 dollars for land-grant college instruction, 8,000,000 dollars for agricultural extension, and 1,000,000 dollars for agricultural research; under a sliding-scale arrangement these amounts might be increased to an annual maximum of 19,480,000 dollars by the beginning of the fiscal year 1940.

As regards agricultural research, the Act contemplated enlarged activities by both the State experiment stations and the Federal Department of Agriculture. Sixty per cent of the amount provided was to be available to the States of the Union, and Alaska, Hawaii and Puerto Rico, the funds allotted being based upon the respective rural populations, and being conditional upon the provision from non-Federal sources of an equivalent amount for purposes of research and for the establishment and maintenance of necessary facilities for the prosecution of such research.

The remaining forty per cent of the research fund was placed directly at the disposal of the Secretary of Agriculture, who was "authorized and directed to conduct research into laws and principles underlying basic problems of agriculture in its broadest aspects; research relating to the improvement of the quality of, and the development of new and improved methods of production of, distribution of, and new and extended uses and markets for, agricultural commodities and by-products and manufactures thereof; and research relating to the conservation, development and use of land and water resources for agricultural purposes" (*Experiment Station Record*, 73, No. 3, 289–91; 1935).

This research was to be conducted by such agencies of the Department of Agriculture as the Secretary might design or establish, but one half of the special research fund was ear-marked to be "used by the Secretary for the establishment and maintenance of research laboratories and facilities in the major agricultural regions at places selected by him, and for the prosecution . . . of research at such laboratories" (*loc. cit.*).

All research by the Department authorized under the Act was to be additional to any provided by existing law, but the desirability of co-ordination of activities was particularly stressed.

So far, nine of these special regional laboratories have been organized, each one being regarded as a co-operative enterprise between the various States concerned, serving as a focal point for co-ordinating and integrating research in its particular problem in its own region, and carrying on basic research along certain lines not already provided for adequately. One of the important reasons for criticizing the organization of agricultural research in the United States, namely, the fact that the agricultural experiment stations of adjacent States situated in the same geographical or agricultural region were carrying out research on very similar problems with little co-ordination as between States, has now to a great extent been removed.

As will be seen from the account of the scope and location of the new regional laboratories given below, anything from eleven to twenty-five States are now co-operating with one or other of the laboratories; the boundaries of a particular problem or branch of agricultural research no longer coincide with State boundaries, but with the limits of the region to which the problem applies more particularly.

The fundamental research for which specialized staff or special equipment or laboratories are essential is done at the regional laboratories; the research which can be carried out at the State experiment stations is still done there; but it is now closely correlated with the work at the regional laboratories, and duplication of work between any of the co-operating States is avoided.

These laboratories are, of course, quite distinct from the other experiment stations and laboratories which have been located on a regional or "problem area" basis, such as the soil and water conservation experiment stations and hydraulic laboratories of the Soil Conservation Service, or the forest and range experiment stations of the Forest Service.

The regional laboratories concerned with research on crop plants and products are three in number; four deal with animal problems, and two with soil-plant relationships.

The U.S. Regional Vegetable Breeding Laboratory (Director: Dr. B. L. Wade) is at Charleston, South Carolina, and was established to obtain the fundamental information necessary for the breeding and development of improved types and varieties of vegetable crops specifically adapted to the south-eastern region; thirteen States are co-operating with this laboratory.

The Pasture Research Laboratory has been established at State College, Pennsylvania, to carry out research on the more fundamental pasture problems of the north-eastern States, the twelve co-operating States continuing to make experiments on the more agronomical aspects. A description of the organization of this Laboratory and of the way in which it co-operates with the States concerned has already been given by its director, Dr. R. J. Garber (*Herb. Rev.*, 6, 146–50; 1938).

The twelve States of the North Central Region are co-operating with the U.S. Regional Soybean Industrial Products Laboratory which has been established at Urbana, Illinois (Director: Dr. R. T. Milner), (1) to develop industrial uses for the soybean and soybean products, (2) to study the effects of different processes on the quantity and quality of products obtained from the soybean, and (3) to provide facilities for testing the quality and adaptability of types and varieties of soybeans for industrial uses.

The four animal laboratories deal with sheep, swine, poultry and animal diseases.

The purpose of the Western Sheep Breeding Laboratory, Dubois, Idaho (Director: Mr. J. E. Nordby), is the development of strains of sheep superior to those now in existence as regards hardiness, and yield and quality of wool and lambs, and the co-ordination of this research with that of the co-operating States (twelve) and Federal experiment stations.

The U.S. Regional Swine Breeding Laboratory has been established at Ames, Iowa (Director: Dr. W. A. Craft), to study the improvement of swine by the application of breeding methods (thirteen States in the North Central Region co-operating).

The object of the Regional Poultry Laboratory, East Lansing, Michigan (Director: Mr. Berley Winton), with which twenty-five States in the North Central and North-eastern Regions are co-operating, is to determine the etiologic agent or agents responsible for fowl paralysis, to develop procedures based upon genetics, management and nutrition, and to discover prophylactic measures for the prevention or control of this disease.

Related to this last laboratory is the work of the Regional Laboratory for Animal Disease Research, at Auburn, Alabama (Director: Mr. B. T. Simms). This Laboratory was established to obtain, with the co-operation of the thirteen States of the South-eastern Region, fundamental information of the mechanism of infection (infection, resistance, immunity) in the contagious, infectious and parasitic diseases of animals and poultry, in order that methods of control of these diseases can be developed or improved. The Laboratory is studying Johne's disease and coccidiosis and internal parasites of cattle.

A Regional Salinity Laboratory, at Riverside, California, has as its objective the obtaining of new information on the reactions of plants and the soil to known concentrations of the several constituents of the dissolved salts contained in supplies of irrigation water and in the soil solutions of irrigated lands. The Laboratory will also ascertain the hydrological and salinity conditions, and the trend of these conditions in representative areas of irrigated lands, in order that the results of these investigations may be constructively applied. Eleven States in the Western Region to which these problems apply are co-operating with this laboratory.

Finally, there has been established at Ithaca, New York, the U.S. Regional Plant Soil and Nutrition Laboratory (Director: Dr. L. A. Maynard), which has very extended terms of reference and the possibility of results which will ultimately have a direct application to the nutrition of domestic animals and the human population throughout the United States.

This laboratory has the following objectives:

(1) To investigate the possibility of influencing the type, character, composition and health of plants grown under controlled environments and in the field through the application of common, rare, or trace elements, irrigation water, sprays, or other means.

(2) To investigate under such conditions the range of variability in the amount of crop produced, the structure of the plant tissue, its mineral, organic and fibre content, and the influence of various environments and environmental factors upon vitamins, growth-promoting substances and other dietary supplemental factors.

(3) To test objectively all these values by feeding the plant produced to the usual laboratory test animals and making observations on rate of development, behaviour, condition, and eventually dietary and nutritional studies.

(4) To determine the dietary needs and tolerance of man and domestic animals for several of the known essential or toxic elements.

(5) To classify geographical regions in the United

States with respect to the adequacy of supplies of different mineral elements through correlated studies of the composition of soils, crops and animals.

(6) To determine methods of adjusting the mineral composition of plants used for animal or human food in various areas of the United States, by the addition of fertilizers carrying the desired elements or by spraying or dusting the plants, or by other means.

(7) To study the efficacy of supplementing mineral-deficient diets of man or animals by the direct addition of minerals and growth substances to the ration.

As the work of this laboratory has a nation-wide significance and application, co-operation will be arranged with those State experiment stations, bureaux of the Department of Agriculture, and other research agencies which already have special facilities and staff members especially interested in one or other of the many aspects of this research.

SCIENCE AND ART AT THE ROYAL ACADEMY

By Dr. A. T. Hopwood

British Museum (Natural History)

THE canons of art differ greatly in detail from those of science, but since intellectual honesty is the basis of both, there is no fundamental distinction between them. To make an orderly statement of accurately observed facts and from those facts to draw logical conclusions is the very essence of science ; but the best art is also logical and orderly, as well as being an accurate interpretation of the impression made by the outside world upon the mind of the artist. Observe the words "interpretation" and "impression" ; they are important because they lie at the very root of the matter ; whereas science is, or should be, strictly objective, art is intensely subjective. For the rest, the differences are mainly those of design, technique, and of the medium of expression. Is it always recognized that there is as much skill in design shown by the well-written and well-balanced scientific paper as there is in a first-class painting, and that when J. M. W. Turner removed a castle bodily from one bank of the river to the other, because in this way he improved the design on his canvas, he was doing no more and no less than the man of science who puts one section of his paper in front of another so as to improve the balance of the whole ? In so far as the man of science recognizes these differences and leaves his prejudices, which are many, outside, so his bewilderment will decrease and his interest and enjoyment increase. In this year's Exhibition at the Royal Academy much is provided to enjoy, and very little to bewilder.

The botanist is always well catered for ; this time he is more fortunate than usual. Apart from the landscapes there is a very large number of flower pieces, which range from W. Rankin's big pictures in the Dutch style, highly finished and accurately drawn, to sketchy impressions incapable of recognition without recourse to the catalogue. "The Change", by Heda Armour, is presumably allegorical and so should be immune from the scientific Philistine, who contents himself with wondering when winter aconite, snowdrops, flag irises and the cuckoo all came together in the same place at the same time. The botanist, too, is this year favoured by the only obvious jest, "The Champion", by J. W. Tucker. This is a monstrous cauliflower to the grower of which homage is being paid by the mayor and corporation with the press and news-reel men in attendance. Mr. Tucker has chosen tempera as his medium and achieved his end, but painting in tempera as practised at the present day does not seem to be suitable for the successful interpretation of flowers, fruit and vegetables. Be the subject what it may, vegetable marrows, carrots, apples, or even the trunks of beech trees, the impression is always of carefully finished plaster models. Incidentally, there is no well-painted fruit this year because of the shortage ; memories have played their owners false and the result is lacking in juice and texture.

Pictures for the zoologist are not many. Two of them, "The Jungle", by Shearer Armstrong, and "The Pine Marten", by Billie Waters, are purely zoological, although the monkeys in the first-named have been somewhat stylized so that one is left uncertain as to what species are intended. For the rest, there are a few shells, particularly good in Mr. Dinkel's "Flower Piece with Shells", some scrawny cats incidental to other subjects, at least one impossible fish, and various kinds of domestic animals of greater or less merit. Among the water-colours, "Flowing Tide" and "Lapwings in Spring", both by C. F. Tunnicliffe, attract attention, but it is in the Sculpture Rooms that zoological subjects are mainly to be found. The best of these are more or less conventional, as, for example, "Yearling", by Raoh Schorr—a bronze statuette of a fawn somewhat after the style of

Skeeping—and "Lamb" by H. Wilson Parker. The horses are not good; one, at least, has the shoulder muscles at fault, and another drags its off hind leg in a painful manner. Neither of the tortoises is particularly successful. The other pieces are competent rather than inspired.

Geologists and mineralogists have very little to claim as their own particular interest, but they share the magnificent painting of the jewellery in Gerald Kelly's charming portrait of Her Majesty the Queen. Precious stones are notoriously difficult to paint; Mr. Kelly has triumphed with a marked economy of pigment and a brilliant sureness of touch.

The mathematician will interest himself mainly in the laws of perspective and their application, and even though there is no solution in paint of a complicated mathematical problem to compare with Mantegna's famous "Dead Christ" or the pulsating rhythm of Uccello's "Rout of San Romano" for him to admire, he would be well advised to examine carefully "Sir Charles Grant Robertson, C.V.O.", by Meredith Frampton, A.R.A., and "Coupons Required", by Leonora K. Green.

As regards physics and chemistry, what is there which concerns them? In a sense the whole exhibition is their oyster. The chemist has a father's interest in the pigments, in their behaviour in mixture, as well as in their use or misuse, while problems of light and shade are for the physicist, who may perhaps one day see a "Portrait of a Sound", even as there has already been a "Photograph of a Smell" (Royal Photographic Society Exhibition, 1938).

Taken as a whole, the exhibits in the South Rooms are not so good as in former years, but there is a very interesting sheet of pencil studies of old agricultural implements—"Details from a Devon Farm", by Russell Flint, R.A. Not only are the drawings pleasing but they are also of historical interest, for they represent a dying phase of agriculture.

At least one man of science always takes a deep breath before venturing into the Architectural Room, for he finds the angularity of "Modern" designs uncomfortable and their curves repellent or even obscene. This year he sighed with relief to find that our English genius has once more triumphed over the upstart invader and that the native tradition still flourishes.

Many words and very little sense have been spent in discussions on modern architecture. Some of its features are admirable; such, for example, are the elimination of waste space and the planning of the fire-places so that the flues run up inside the building instead of dissipating their heat through outside walls. White houses in England there always have been, and coloured roofs as well; the change is in the substitution of more permanent materials for whitewash and in the addition of deep blue and green glazed tiles to the traditional unglazed red.

One's quarrel is with none of these things, but with the perverse body which insists on being revolutionary. The fact that steel and concrete can be made to assume certain forms does not mean that it is desirable that it should be made to assume those forms. That light and fresh air are essential to health is no excuse for designing windows so large that the illuminated rooms are impossible to keep warm during cold weather. As for severity of line and beauty of well-proportioned masses, a boot-box can be severe and well proportioned, but what is suitable for a boot-box is not necessarily suitable for a dwelling-house. There are three parties interested in houses: the housewife, who requires ease of working, the householder, who requires comfort as well as value for money paid, and the community, which has the right to demand that a building shall consort amicably with its surroundings. Unless the architect can satisfy all three he has failed. It is much to their credit that the architectural exhibits in the Academy this year make an honest attempt to fulfil these conditions; and even if there are still such curiosities as windows in which the length of the pane is horizontal instead of upright, the vulgarity of the extreme modern school—vulgar just because it is extreme—is nowhere to be seen.

OBITUARIES

Dr. G. W. C. Kaye, O.B.E., F.R.S.

DR. GEORGE WILLIAM CLARKSON KAYE, superintendent of the Physics Department, National Physical Laboratory, passed away on April 16 after a long illness. His name became familiar to students of science thirty years ago as the co-author of "Tables of Physical and Chemical Constants", which have now reached their eighth edition. He was born in 1880 and studied physics at the Imperial College of Science, then the Royal College of Science, and later at Trinity College, Cambridge. For Cambridge he retained a warm affection throughout his life, and he was at his best when showing a friend round the colleges and the Cavendish Laboratory. For a time he assisted Sir J. J. Thomson in his research work.

Kaye joined the staff of the National Physical Laboratory in 1910, and at first worked in the Metrology Department on the production of a silica standard of length. In 1912 he was transferred to the Physics Department to take charge of the thermometer testing work, then taken over from Kew Observatory, and of radium measurements.

As a captain in the London Electrical Engineers R.E.(T.), he was called to the colours in August 1914 and for a time served at a Thames Estuary Station on searchlight work. Later he transferred to the Aeronautical Inspection Directorate of the Air Ministry, in which organization he rose ultimately to the position of chief inspector of materials, with the rank of major. It was in this position that he applied X-rays to the examination of various types of timber splices. The A.I.D. gave him much experience in the handling of men of many types and of committee work, which appealed especially to him. On his return to the National Physical Laboratory, he took charge of the Physics Department and was appointed superintendent in 1922. He was primarily interested in the administrative side of the work and for more than twenty years he was chairman of the Library Committee of the Laboratory.

Kaye was especially interested in the British X-ray and Radium Protection Committee, and took an active part in the deliberations of the International X-Ray and Radium Protection Commission of the various Congresses of Radiology. He gave the eighth Caldwell Memorial Lecture before the American Roentgen Ray Society in Montreal in 1927, and his presidential address to the British Institute of Radiology in 1929 was entitled "Radiology, Medieval and Modern". At one time thermal measurements attracted his attention, and a number of papers were published jointly with various colleagues.

It was not, however, until the need arose for the inclusion of the subject of sound in the activities of the National Physical Laboratory that Kaye found scope for his special talents. He took great pride in the design of the new Acoustics Laboratory, and neither time nor money was spared to ensure that Great Britain should be in the forefront as regards equipment for the study of the acoustics of buildings and allied problems. Special attention was devoted to noise measurements, on which subject a number of papers was published. These constituted the basis of his presidential address to Section A of the British Association at the Nottingham meeting in 1937. His election to the presidency of Section A afforded him the deepest satisfaction, and much time was spent in the preparation of his address, which was lavishly illustrated by experiments and with a cinematograph film.

Soon after Kaye became superintendent of the Physical Department of the National Physical Laboratory, it had become apparent that a rehousing of the Department was necessary. He undertook wholeheartedly the task of specifying the requirements of the Department and, in conjunction with the then Office of Works, in preparing the basic plans of the present structure. Many times the schemes were turned down for reasons of economy. This delay did not prevent Kaye from keeping the plans abreast of modern requirements, and features of the building have since been incorporated in other new laboratories built in Great Britain.

Kaye was the recipient of many honours, which included the Mackenzie Davidson Medal of the Royal Society of Medicine and the Silvanus Thompson Medal of the British Institute of Radiology. He was elected a fellow of the Royal Society in 1939.

Ezer Griffiths.

Prof. Charles Laubry

By the death of Prof. Charles Laubry of Paris at the age of sixty-eight, the announcement of which rapidly follows that of Prof. Wenckebach's (see Nature, March 1, 1941, p. 260), though the exact date is unascertainable in present circumstances, medical science has lost another pioneer in modern cardiology, and particularly in the application of radiology to diseases of the heart.

Laubry was a pupil of the late Prof. Vaquez of Paris, whose school exercised a great influence over current cardiological teaching throughout Europe and Latin America, though less in Great Britain and the United States. His literary output was considerable. His principal works in chronological order were: "Leçons de sémiologie cardiovasculaire. Les troubles fonctionnels" (1924), "Traité des maladies congénitales du cœur" in collaboration with Pezzi of Milan (1926), and "Radiologie clinique du cœur et des grands vaisseaux" in collaboration with Cottenot, Routier and Heim de Balsac (1939). He was also editor of the *Archives des maladies du cœur.*

In addition to his cardiological work, he was the author of the section on the symptomatology of diseases of the respiratory system in the third volume of the "Nouveau Traité de Pathologie Interne" (1938).

Like Prof. Wenkebach, Laubry had many friends in Great Britain. He delivered the Saint Cyres Lecture at the National Heart Hospital in 1937, and he was an honorary member of the Cardiac Society. He was elected an honorary foreign fellow of the Royal Society of Medicine in 1939.

We regret to announce the following deaths:

Mr. N. C. Brown, known for his work on the distribution and habits of North American birds, on March 20, aged eighty-four.

Sir James Frazer, O.M., F.R.S., the well-known anthropologist and author of the "Golden Bough", and Lady Frazer, on May 7, aged eighty-seven.

Prof. G. L. Gulland, C.M.G., emeritus professor of medicine in the University of Edinburgh, on May 4.

Prof. L. Kahlenberg, formerly professor of chemistry in the University of Wisconsin, on March 19, aged seventy-one.

Prof. Nikolaj Konstantinovic Koltzoff, director of the Moscow Institute of Experimental Biology, aged sixty-nine; in making this announcement in Nature of April 19, p. 474, Prof. Koltzoff's surname was omitted.

Prof. A. C. Pereira, professor of toxicology in the University of Lisbon, on December 20, aged seventy-three.

NEWS AND VIEWS

Terrorism in Aerial Attack

THOSE of us who experienced the heavy attack on London by the German Air Force on Saturday night (May 10–11) were once more convinced of its deliberately indiscriminate nature with the obvious aim of striking terror into the hearts of Londoners—an aim as ineffectual as it was barbaric. Never has there been a raid in which so much damage was done, in brilliant moonlight, to buildings of architectural and cultural value—Westminster Abbey, Dean's Yard, Westminster Hall, the Houses of Parliament, the British Museum, etc. On the other hand, we venture to say, never was there a raid in which so little damage was done to objectives of military importance. One of the editors of NATURE had occasion to go from Westminster through a heavily raided area while the attack was at its height; and once again he was firmly convinced of the absolute futility of this form of attack—futile from the point of view of the Nazis' own war strategy. For the enemy did nothing to further his own aims, though he did much against them in rousing the ire of the British and, afterwards, the contempt of every balanced thinker throughout the world.

The *Völkischer Beobachter* stated that "British broadcasting reports that London is one single sea of flames—the Luftwaffe's heaviest retaliation attack on the British metropolis". Retaliation, in modern warfare, is useless; it is merely an expression of hysteria. The same newspaper asserted that "Naturally the British again assert that our mass attack was indiscriminate, but the High Command reports objectively that the region round the bend of the Thames—that is, the centre of London's docks and business quarters, was again the focus of attack". The considerable area through which one of the editors passed was being deliberately attacked and continued to be the objective of incendiaries and high explosives for several hours. That area is miles from the London docks. Furthermore, nowhere did he see signs of terror, but heroic battling with the fires and grim though calm working on ruined buildings while bombs continued to rain down. No amount of this kind of brutal bombing of buildings which are a nation's—even a world's—heritage and of helpless civilians can bring such a people to its knees. Neither can it help the enemy one jot; rather does it condemn him as unworthy of the wonderful heritage that should be his in his own country, unworthy of all that art and science are able to place at his disposal. Other cities—Plymouth, Bristol, Liverpool, Glasgow, Manchester, Birmingham and many others—will assuredly voice the same opinion.

New Type of Airscrew

INFORMATION has just been released of the successful use of a new type of airscrew on British aircraft, principally those of the Fleet Air Arm operating from the deck of an aircraft carrier. It consists of two co-axial airscrews, one directly behind the other, rotating in opposite directions, each having controllable pitch blades. The development of this device, known as a 'Contraprop', is due to the necessity for turning into thrust the rapidly increasing horse-power being given by the latest aero-engines. Up to 2,000 h.p. is now given by engines coming into service, which on certain types of fighters gives speeds of more than four hundred miles per hour.

The principal trouble in absorbing such powers has been the increase of diameter of the airscrew. The limit, both aerodynamical and practical, is now about reached, in the increase of diameter and multiplication of blades. The placing of one propeller behind the other defeats both of these troubles and simplifies the problem of undercarriage design, especially of the tricycle type, by allowing the machine to be lower, as the smaller diameter needs less ground clearance. Airscrew torque, which causes a machine to tend to swing to one side when taking off, is cancelled out by the opposing directions of rotation. This is important in the case of machines taking off from a confined space such as an aircraft carrier's deck. The absence of torque also increases the rapidity of certain manœuvres in the air. A special control, combined with the adjustable pitch mechanism, enables either propeller to be kept working if the other is damaged, which in effect increases the reliability of the power unit as a whole. For fighting purposes it is made so that cannon can fire through the centre of the hub if required. It is claimed that the device can be produced at no greater weight than a single propeller capable of absorbing equivalent power.

The Transport Problem in Great Britain

THE appointment of Mr. F. J. Leathers to the new post of Minister of War-time Communications, thus combining the duties of Minister of Transport and Minister of Shipping, is to some extent an answer to criticisms of the transport systems of Great Britain made in the eighth and tenth reports of the Select Committee on National Expenditure. Both reports are highly critical of the lack of foresight which has allowed the present shortage of coal supplies and stocks and the difficulties in handling shipping at the docks to develop. Even under war conditions, the Sub-Committee on Transport Services considers that a ship can be unloaded and loaded again more quickly than transport can take traffic from, or bring traffic to, the ports. The failure to secure the existence of equipment such as powerful cranes and elevators which could be transported to and erected at the ports where need arose is strongly condemned. The Sub-Committee recommends the acceleration of delivery or transfer of such mechanical equipment and also that there should be no cessation of work in ports during 'alerts' unless danger is imminent. While the appointment of regional port directors by the Minister of Transport has been welcomed, the Sub-Committee points out that time alone will show whether such appointments, in some cases of men without previous experience of all the ramification of shipping and port management, is likely to bring success in discharging adequately and efficiently the very onerous responsibilities involved in securing the rapid clearance of both ports and ships.

Other recommendations in the tenth report include the acceleration of manufacture of railway wagons of special type ; closer co-operation at overseas ports between the Ministries of Shipping and Transport so that cargoes may be more suitably arranged with a view to their ultimate destinations ; transfer of suitable engineers from industry to the merchant service and employment of an experienced shipbuilding engineer to visit repairing yards and suggest improvements in mechanical equipment. More ship repairs should, where possible, be effected abroad and among all practicable steps to overcome transport difficulties, the Sub-Committee reiterates its recommendation in the eighth report that particular attention should be directed to the possibility of curtailing or withdrawing passenger trains on specified days to permit more freight trains to be moved.

While the Sub-Committee considers that it is impracticable in war-time to contemplate a scheme submitted to them for concentrating railway traffic at stations 20 or 30 miles apart for exchange with road vehicles, and closing intermediate stations, such a scheme might repay further consideration after the War. In the meantime the Sub-Committee is awaiting the results of an investigation of the possibility of greater use being made of the canal system and also of proposals for using road transport in greater volume to assist the railways in clearing docks and other centres. It severely criticizes the failure of Government departments to consult the Mines Department when extensions or new factories are planned, and recommends that such Departments should be required to provide the Mines Department with quarterly estimates in advance in areas where supplies are short and future needs will expand. It also recommends that a more comprehensive scheme be planned at once to create coal stocks to meet next winter's demands, and that closer co-operation should be organized between coal merchants to pool requirements of stocks of household coal, labour and local transport.

British Standards Institution

SOME months before the outbreak of war, the British Standards Institution offered the Government its services, as a complete unit, in the national emergency. This offer, which was sent to the Board of Trade, through which the Institution receives its Government grant, was cordially received. On the outbreak of war, the Institution set up a number of small executive committees for the various sections of its work, these being made fully responsible for the preparation of any war emergency specifications required. A statement has now been issued outlining the Institution's recent activities. The Institution has been invited to send a representative to appropriate meetings of the Materials Committee of the Production Executive, which is representative of all Government departments, the Central Priority Department acting as the liaison between that Committee and the Institution. The first issue of the War Emergency Specifications for Tins and Cans for food products and other commodities is estimated to have saved 40,000 tons of steel in the first year, while it is estimated that the War Emergency Specification for Bolts and Nuts with smaller heads will save many thousands of tons of steel a year.

Another example of the work of the Institution concerns alloy and special steels. A committee under the chairmanship of Dr. W. H. Hatfield, has for some time past been engaged on an investigation of this complex problem and has drawn up a confidential report which includes suggestions for a co-ordinated series of steels. Such sections of the report as can be made available to the engineering public are being issued by the Institution, which at the same time is issuing War Emergency British Standards covering the steels recommended in the report. The Ministry of Works and Buildings is using the Institution for the promulgation, under its authority, of a series of War Emergency British Standards, and about fifty specifications in connexion with A.R.P. work have been issued at the request of the Ministry of Home Security.

Such work of immediate importance has not prevented the British Standards Institution from maintaining its close relationship with the Dominions' standardizing bodies. In addition, the Institution's Committee in the Argentine Republic, which is working in close collaboration with the Argentine national standards organization, is receiving increased recognition, as its work is seen to be of real value to British export trade. British engineers and traders in the Argentine are to a greater degree giving practical support to the work of the Committee. The Institution, with the help of the British Council and of industry, is also engaged in compiling a number of technical handbooks dealing with British industrial practice. The books are to be published in Spanish and Turkish.

Gypsy-Lore

EVER since the time of Borrow the mystery of the gypsy-folk has intrigued those of us who have seen, and still occasionally see, their caravans encamped in some lovely dell ; and Borrow would have been the first to welcome the serious study which since his day has been devoted to these people so that now we know much more about them than he could. The mystery, however, still remains. The current number of the *Journal of the Gypsy-Lore Society* makes interesting reading, its subject-matter ranging from the sixteenth century in Transylvania to modern times in Spain. Especially dramatic, if of no great scientific importance, is the account of an unusual friendship struck up between an Englishman and a gypsy youth as the result of help given in a brawl in a Montparnasse estaminet. The two eventually travelled together to visit the gypsy's parents in Madrid—shortly before the lad himself was killed in an accident.

The gypsy language naturally becomes modified by the speech of the people among whom the wanderers have penetrated. Thus Bosnian Romani shows signs of the influence of the Slavonic language with which it is most closely associated, and in this connexion a preliminary study of Bosnian Romani and of certain North Albanian texts will doubtless be of interest to language students. One cannot help wondering what these alien wanderers who still survive among so many of the warring European nations can be thinking, if they think so widely, of the present suicidal struggle of their hosts.

Place-Names in the United States

THAT the study of place-names, apart from its intrinsic interest, is an invaluable source of illuminating evidence for archæologist, anthropologist and social historian, has become a commonplace among all who are familiar with the publications of the English Place-Name Society. Analogous studies of place-names of Indian origin have been made in the United States; but there the untrustworthy character of early documents, if not their complete absence, is a difficulty which is only partially overcome by reference to those few survivors who are still acquainted with the original Indian language. Dr. J. P. Harrington, of the Smithsonian Institution, arrives at the meaning of names of Indian origin in the eastern United States by reference to Delawares now resident in eastern Oklahoma, whose language is one of the few eastern languages still surviving, predominantly the tongue of the Pennsylvanian Indians at the time of first settlement. It is interesting to note that many place-name elements were immediately recognized by living Delawares, but others remained doubtful, even when the words were reconstructed by them out of the basic elements of their language. Of the names submitted for interpretation, "Chesapeke", for long a puzzle to students, is said to be "salt bay" from *chesa* = salt and *peekw* = body of water. Susquehanna is "muddy river", and Monongahela, "caving banks". Potomac, which previously had been interpreted as "carrying place" or "centre for trading", is now construed in the opposite sense as a place where a man lays down a burden, resting place—presumably the place at which Indian war or trading parties took a rest when they came in sight of some village approximately in the present position of the city of Washington.

Indian Fisheries

A report on a survey of the fisheries of Bengal by Dr. R. Naidu (Bengal Govt. Press, 1939) which has only recently been received, contains valuable information on the present state of the Indian fisheries. There is a descriptive account of the fishing methods, followed by details of the commercially exploited groups of fishes in the different parts of Bengal and of the recent work done in other provinces to improve the fisheries. The hilsa or the Indian shad (*Hilsa ilisha*) is the most popular food fish of Bengal; the report makes it clear that unless hatcheries are provided and protective legislation enacted, this valuable fishery will rapidly be depleted at the present rate of fishing. The condition of the carp fisheries, which come next in importance, is equally unsatisfactory, for, though carp culture is widely practised in Bengal, the methods in vogue are wasteful and destructive. The dried fish and prawn industries are considerably developed in the province, but the methods of preparation of the products for the market leave much to be desired. Analysis of the fishing trade points to the deplorable economic condition of the fishing populations who form the backbone of the industry; though fish are plentiful and prices high, a disproportionately high percentage of the profits go to the middlemen who intervene between the fishermen and the consumers. The recommendations made include the organization of a new department with properly equipped stations and personnel, and if given effect to, should substantially improve the fishing industry of the province. Bengal had a separate fisheries department for some time, but it was abolished in 1923. From the facts presented in the report it is difficult to understand how the fisheries of the province could be improved without a properly organized fishery administration.

It is impossible to exaggerate the necessity for developing the fisheries in a country like India where a high percentage of the population is undernourished; the supply of good fish throughout the country by efficient methods of storage and transport would not only raise the nutritional standards of the people but would form also the basis of an industry which has great scope for expansion. We understand that quick-freezing refrigeration plants have already been installed in some parts of India. There is, unfortunately, no organized plan of development of the fisheries of the country as a whole; while some provinces like Madras are ahead of the others, most provinces have no fishery departments at all. The attitude of the provincial Governments seems to be that the departments should mainly rely on their own income for expansion; this short-sighted policy has very much limited the activities of the existing departments. Much work remains to be done to elucidate the habits and life-histories of Indian food fishes. Recent work on some of them has been noticed in NATURE (146, 657; 1940). The problem is too vast to be tackled by the fisheries departments alone. We venture to suggest that they should enlist the co-operation of Indian universities and other institutes which have provision for post-graduate research, by providing grants-in-aid for investigating specified problems. In any case a central body to co-ordinate the work done at the different centres would be essential.

Private Estates and Forestry

A paper on this subject was read by Major C. P. Ackers before the Royal Society of Arts on February 26, 1941. Some introductory remarks on the history of forestry in Great Britain were made and forestry education was alluded to. It is incorrect to say that forestry education seriously started at Oxford under the late Sir William Somerville. The late Sir William Schlich took forestry to Oxford when the R.I.E. College, Coopers Hill, was closed in 1905. Somerville was the first lecturer in forestry at the University of Edinburgh; afterwards his connexion was with agriculture. Major Ackers correctly states that the position of British woodlands of all types and ownership had sunk to a very low management before the War of 1914–18 and with the exception of the afforestation work of the Forestry Commission and a few isolated private instances the management has scarcely improved since.

Some of the author's ideas for improvement of forestry in Great Britain will not receive general endorsement. Sylviculturally the suggestion that whenever the prospects are reasonably in favour, mixed crops of conifers and hardwoods should be grown, is sound. Such mixtures are admittedly more difficult to manage than pure crops or mixed crops of conifers. But it is true to say that in many parts of England and certain parts of Scotland and Wales they would fulfil soil requirements and the local country-side markets, besides re-introducing small local industries. Although it must remain true that Great Britain could never grow enough wood, etc., to supply the requirements of its population, yet with equal truth it may be asseverated that a long-term policy is essential. Such an indispensable condition has so far never been conceded by either Government or private owner.

Swine Influenza in Britain

In a paper on this subject read before the Section of Comparative Medicine of the Royal Society of Medicine on April 23, Mr. F. Blakemore said that swine influenza has been extensively studied in America and a somewhat similar disease named *Ferkelgrippe* has been described in Germany and most European countries, including Northern Ireland. It has not been recorded in Great Britain, but many clinicians maintain that a specific pneumonia causes considerable loss, so that it is important to study the etiology of the disease and ascertain its relationship to conditions investigated elsewhere. An outbreak of influenza affecting pigs 10–14 weeks old in which the symptoms were typical of those described by Shope in America was investigated. In severe cases there was a lobular pneumonia affecting principally the anterior lobes. The mortality was low but recovery was slow.

Hæmophilus influenzæ was recorded from half the pigs examined, and the presence of a virus was demonstrated by the intranasal instillation of a filtrate of pneumonic lung. The virus was afterwards established in ferrets, and neutralizing antibodies were demonstrated in the blood of convalescent pigs to the ferret-adapted virus. An investigation of a further four selected outbreaks of pneumonia in pigs revealed the presence of a virus and in two of these the agent was adapted to the ferret. *Hæmophilus influenzæ* was obtained from only a few of the pigs; other infecting bacteria were *Pasteurella suiseptica*, *Br. bronchiseptica*, Salmonella, streptococci and unidentified Gram-positive bacilli. An attempt was made to ascertain the incidence of influenzal pneumonia by examining the lungs of pigs at a public slaughterhouse. Lesions of the kind found in outbreaks previously studied were observed in a proportion of cases. *Hæmophilus influenzæ* was recovered from three of forty affected lungs obtained from the slaughterhouse. Transmission experiments with material from two lungs were carried out. The disease was readily reproduced in pigs, and one of the strains was later adapted to the ferret.

Effect of Low Temperatures on Aircraft Metals

Temperatures as low as −60° C. may be reached by parts of the structures of aircraft flying at great heights. S. J. Rosenberg (*J. Res.*, *Nat. Bur. Stand.*, 25, 673; 1940) has examined the effect of low temperatures, down to −78° C., upon the tensile properties, hardness, and impact resistance of metals commonly used in building aircraft. For the materials tested, including ferritic steels, austenitic stainless steels and nickel alloys and light metal alloys (Al- and Mg-base), none of these mechanical properties was adversely affected by low temperatures with the exception of a decrease in impact resistance of ferritic steels as the temperature fell. In common with all papers published in this journal, the present paper may be bought as a separate reprint (Research Paper R.P. 1347), from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

Dr. James Hope

Dr. James Hope, one of the most eminent London physicians of the first half of the nineteenth century and one who contributed much to our knowledge of diseases of the heart, was born at Stockport, Cheshire, on February 23, 1801, the tenth of a family of twelve. He studied medicine at Edinburgh, where he qualified in 1825 with a thesis on aneurysm of the aorta. After spending two years in foreign travel including a year in Paris under Chomel, he settled in London in 1828 and soon acquired an extensive practice. He made numerous contributions to periodic literature on heart disease, and in 1831 published his chief work entitled "A Treatise on Diseases of the Heart and Great Vessels", which comprised a new view of the physiology of the heart's action according to which the physical signs are explained. In the following year he was elected a fellow of the Royal Society. In 1834 he was elected assistant physician and in 1839 full physician to St. George's Hospital. His second most important work was published in 1833 and 1834, entitled "Principles and Illustrations of Morbid Anatomy adapted to the Elements of

M. Andral and to the Cyclopædia of Practical Medicine, being a complete series of coloured lithographic drawings from originals by the author". He died on May 12, 1841, at the early age of forty.

Spectrochemical Literature

THE second volume of *Spectrochemical Abstracts*, covering the years 1938–39 and edited by E. H. S. van Someren, has just been issued by Messrs. A. Hilger, 98 St. Pancras Way, N.W.1. More than 150 papers and books are listed under authors' names, and the classification of substances analysed and elements determined is very thorough. The pamphlet is a valuable summary of material scattered in many journals.

Books and papers of metallurgical interest are similarly covered by the *Bibliography of Spectrochemical Analysis* compiled by D. M. Smith and published by the British Non-Ferrous Metals Research Association, Euston Street, N.W.1. The second edition, costing three shillings, has been brought up to date, to August 1940, and now includes more than five hundred entries. A new section on Application of the Microphotometer lists twenty-one researches. Short explanatory notes are given with most of the references and an author index is provided.

Earthquake in Manchuria

AN earthquake of considerable intensity is reported to have taken place early on May 6 in northern Manchuria. Insufficient reports have so far been received to fix the epicentre with any precision but it must have been fairly close to Suihwa, forty miles north-east of Harbin, where thirty-three were killed and several injured. It is also reported that scores were killed and injured in other nearby cities. It will be recalled that one of the larger earthquakes of 1940 took place in Manchuria on July 10.

Institution of Electrical Engineers: Awards

THE Council of the Institution of Electrical Engineers has made the following award of premiums for papers read during the session 1940–41, or accepted for publication: *Institution Premium:* Mr. C. F. Booth; *Ayrton Premium:* Mr. W. A. Cook; *Fahie Premium:* Messrs. A. Fairweather and J. Ingham; *John Hopkinson Premium:* Mr. G. H. Rawcliffe; *Kelvin Premium:* Messrs. C. E. R. Bruce and R. H. Golde; *Extra Premiums:* Mr. C. G. Garton, Messrs. L. Gosland and W. F. M. Dunne, Prof. Willis Jackson and Mr. A. E. Chester, Dr. R. Jessel, Messrs. W. J. Mason and S. A. G. Emms, Mr. G. H. Metson, Mr. A. Langley Morris; *Wireless Section Premiums:* Messrs. N. M. Rust, O. E. Keall, J. F. Ramsay and Dr. K. R. Sturley (Ambrose Fleming Premium), Messrs. C. A. Mason and J. Moir, Dr. R. H. Barfield; *Meter and Instrument Section Premiums:* Dr. A. E. W. Austen and Dr. S. Whitehead, Mr. A. J. King, Dr. R. W. Guelke, Mr. C. R. Maguire and Dr. R. A. Scott; *Transmission Section Premiums:* Mr. F. R. Perry (Sebastian de Ferranti Premium), Dr. C. Dannatt and R. A. Polson.

Announcements

THE Sir John Kennedy Medal of the Engineering Institute of Canada has been presented to Lieutenant-General A. G. L. McNaughton, commander of the Canadian Corps in Great Britain and lately president of the National Research Council of Canada. General McNaughton described the present position of research in Canada before a meeting of the Royal Society of Arts on May 13; we hope to print a substantial part of this lecture in an early issue.

PROF. L. G. M. BAAS BECKING, professor of botany in the University of Leyden and director of the well-known Leyden Botanical Gardens (NATURE, 142, 1013; 1938), is now in custody in a prison at Scheveningen, Holland.

DR. THOMAS MIDGLEY, JUN., of Kinetic Chemicals, Inc., has been awarded the Priestley Medal, the highest award of the American Chemical Society, for his discovery of the anti-knock properties of tetraethyl lead, as well as other outstanding achievements in chemical science. Dr. Midgley has already been awarded the Nichols, Longstreth and Perkin Medals.

THE thirty-first annual May Lecture of the Institute of Metals will be delivered in the New Clarendon Laboratory, Oxford, by Dr. F. Simon, reader in thermodynamics in the University of Oxford, on May 28. Dr. Simon will speak on "The Significance of Low Temperature Research". Admission is by ticket, obtainable free of charge, from the Secretary, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1, or the Secretary, Clarendon Laboratory, University Museum, Oxford.

THE following appointments in the Colonial Service have recently been announced: D. T. Lloyd, surveyor, Sierra Leone; E. B. Lambert (assistant superintendent of Crown lands), superintendent of Crown lands and surveys, Hong Kong; L. Lord (formerly divisional agricultural officer, Ceylon), secretary to Colonial Advisory Council of Agriculture and Animal Health and assistant to Agricultural Adviser, Colonial Office.

THE following appointments in the University of Sheffield have recently been made: Dr. S. A. Peyton, University librarian; Mr. F. J. S. Esher, assistant lecturer in mental diseases; Mr. M. Laird, junior demonstrator in anatomy; Mrs. Mildred John, part-time demonstrator in anatomy.

The Council has received from the executor of the late Mrs. E. G. Willis a cheque for £1,000 in payment of a legacy left to the University for the foundation of a scholarship in engineering or metallurgy in memory of her late husband, Mr. T. W. Willis.

The collaborators of the late Prof. R. V. Wheeler have presented to the University a complete set of his published researches, together with a glass cabinet to contain the volumes.

The Council has received the resignation of Dr. F. E. E. Schneider of his post of assistant lecturer in mental diseases, and Mr. T. C. Joyce of his post of lecturer in electrical engineering.

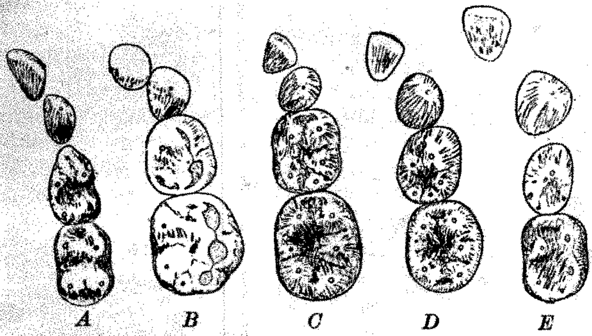
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Mandible of a Young Paranthropus Child

ONE of the difficulties in making comparisons of the Taungs and the Sterkfontein and Kromdraai apes has been that the Taungs ape is only known by the skull of a 4–5-year-old child, while the other apes are only known by adult specimens and a fragment of the jaw of a 10-year-old Sterkfontein ape. Now fortunately we have a little further evidence.



RIGHT LOWER MILK DENTITION OF VARIOUS PRIMATES AND MAN. FIRST INCISOR HAS BEEN OMITTED AS IT IS UNKNOWN IN PARANTHROPUS AND IMPERFECT IN AUSTRALOPITHECUS.

A, Baboon (*Papio comatus*), probably female; *B*, Taungs ape (*Australopithecus africanus*), possibly male; *C*, Kromdraai ape (*Paranthropus robustus*), probably female; *D*, Kaffir child (*Homo sapiens*); *E*, chimpanzee (*Pan* sp.), probably female. All figures very slightly enlarged.

For more than a year, owing to the War and other conditions, no work has been done at Sterkfontein or Kromdraai; but three weeks ago I went out to Kromdraai and set my assistant to work at a promising spot. He was immediately successful in getting part of a lower jaw with beautifully preserved teeth of a child ape a little younger than the Taungs child. The right second incisor, the canine, and the two milk molars are almost perfectly preserved and scarcely worn. The first true molar is satisfactorily preserved, but had not yet cut the gum.

On the left side we have the first milk molar and part of the canine.

There can be little doubt that this is the jaw of a young *Paranthropus robustus*. It was found within 6 ft. of the spot where the type was discovered. The first true molar is a little smaller than in the type, and this new specimen is probably a female.

When the teeth are compared with those of the Taungs ape (Australopithecus) it is manifest that the two young forms belong to different genera. I give drawings of these teeth, with for comparison drawings of the lower milk teeth in a number of other Primates and man. If the Australopithecus teeth are compared with those of Paranthropus, it will be seen that they all differ very considerably. The Paranthropus second incisor is much smaller than in Australopithecus, and so is the canine. The first milk molar in Paranthropus, while essentially similar in structure to that of the Taungs ape, differs markedly in the shape and in the arrangement of the cusps. The second molar is longer and narrower than in the Taungs ape, and it also differs considerably in the arrangement of the cusps.

There is little doubt Paranthropus and Australopithecus belong to the same family, but they cannot be very closely allied.

If the human milk molars are compared with those of Australopithecus and of Paranthropus it will be seen that there is considerable agreement, and one might almost consider the possibility of all three types belonging to one family. There must be some close affinity.

If we compare the Australopithecine and the human teeth with those of the chimpanzee we at once see a very marked difference. In the chimpanzee the second incisor and canine are much larger than in these others, and differently arranged; while the first milk molar is so very unlike those of the other forms here shown that any affinity must be remote.

In the gorilla and the gibbon, according to figures published by Röse, the first lower milk molars have a single main cusp which is clearly the antero-external cusp of the human milk premolar. In some specimens of the gorilla tooth there appears to be also a rudiment of the antero-internal cusp. In the chimpanzee there is generally a rudiment of the antero-internal cusp close to the large main cusp. In the orang there are also the two cusps practically fused into one. A glance at the figure given of the chimpanzee tooth will show how greatly it differs from the teeth of the Australopithecines.

The second milk molar of Paranthropus has the usual five cusps seen in the corresponding human tooth. It also has a little cusp between the two main inner cusps. This little extra cusp is frequently found in man. It is a Cercopithecid character that has been retained. The Paranthropus tooth is also interesting in having a very marked anterior fovea. This is a typical human character. It is present in all the Kaffir baby skulls I have examined. It is present, but much less developed, in Australopithecus. This is also a Cercopithecid character. It is well marked in the gorilla and the orang, but rather less developed in the chimpanzee.

It is interesting to observe that the probably Lower Pleistocene Australopithecus, in the structure of its milk teeth, comes considerably nearer to man than does the much later and probably Middle Pleistocene Paranthropus; and that neither of the fossil forms has any close affinity with the living anthropoids, all of which have specialized away from the ancestral type. Paranthropus retains a few more Cercopithecid characters than does Australopithecus, or man.

R. BROOM.

Transvaal Museum,
Pretoria.
April 6.

Influence of Vitamin D upon the Incisor Teeth of Rachitic Rats

IT has long been known that vitamin D exerts a profound influence upon the calcification of developing teeth. The action of this vitamin in massive doses upon the persistently growing incisor of the rat has been described by Schour and Ham[1] in the normal animal and by Schour, Tweedy, Chandler and Engel[2] after parathyroidectomy. In both cases the change in the dentin consisted in essentials of a hypocalcified stripe followed by a reactive hypercalcified zone. It does not appear, however, that the reaction of the dentin has been followed in rachitic rats given curative doses of the vitamin.

Through the kindness of Dr. H. A. Shapiro of the Union Health Department, I have been able to examine the teeth of rats used for vitamin D assay. The negative controls were given for 31 days a rachitogenic diet with a Ca/P ratio of 4·8. The treated animals were on this diet the same length of time but received in addition a dose of 9·2 I.U. of vitamin D on the twenty-first day. Both sets of animals were killed and examined on the thirty-first day. The upper incisor teeth were cut in longitudinal section and the changes in the dentin were investigated.

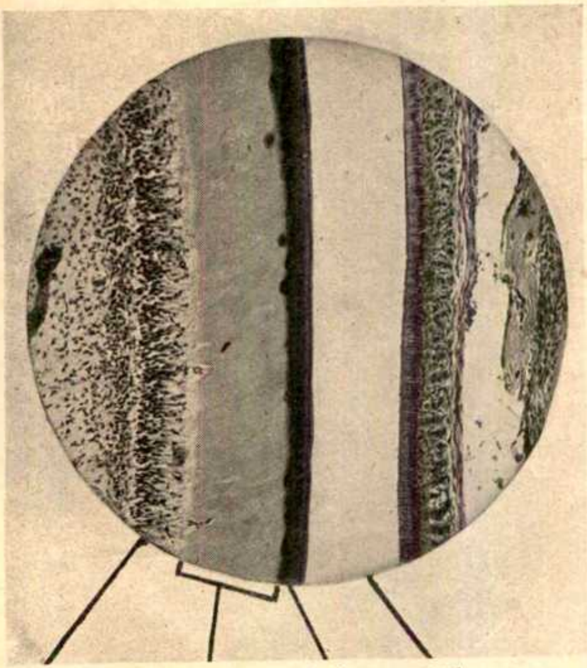


Fig. 1.

LONGITUDINAL SECTION OF THE UPPER INCISOR TOOTH OF A RAT ON THE VITAMIN-FREE DIET FOR 31 DAYS. NOTE VERY WIDE PREDENTIN. × 90. (No. 8.)

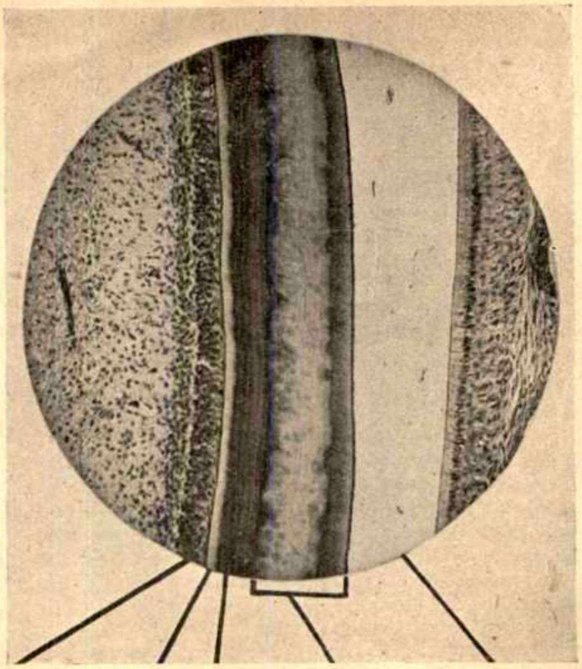


Fig. 2.

LONGITUDINAL SECTION OF THE UPPER INCISOR TOOTH OF A RAT ON THE AVITAMINOUS DIET FOR 31 DAYS AND WHICH RECEIVED 9·2 I.U. OF VITAMIN D ON THE 21ST DAY. NOTE THE DENTIN AND PREDENTIN FORMED BEFORE THE DOSE OF D WAS GIVEN AND THE REACTIVE DENTIN AND PREDENTIN FORMED UNDER THE INFLUENCE OF THE VITAMIN. × 90. (No. 4.)

The incisors of the three negative control animals studied all showed in the dentin the changes usually found in this condition—very wide predentin with vascular inclusions in several places (Fig. 1). Marked changes in the enamel and enamel organ not pertinent to the present study were also found.

The teeth of the six animals which had received the dose of vitamin D all had a markedly different appearance from that noted in the controls. The changes in these teeth were all the same in type, varying somewhat from animal to animal (Fig. 2). In each, a reactive stripe of new dentin, staining deeply with hæmatoxylin, was laid down as a result of vitamin medication. This intense calcification affected only the dentin matrix laid down after the vitamin had been given. The predentin laid down previous to this was either completely unchanged or else showed a few scattered calcified granules; and in some cases a little calcification had occurred round the vascular inclusions, giving the appearance of finger-like projections of hæmatoxylin-staining material into the old predentin. The contrast between the dentin calcified before and after giving the vitamin was very marked, as can be seen from Fig. 2. It is difficult to understand why the old predentin was not more altered, seeing that this was being calcified, though with difficulty, while the animal was on the deficient diet alone. A similar inability to calcify predentin laid down during a dietary deficiency has been noted when animals on a magnesium-deficient diet are returned to one of normal magnesium content[3].

The new dentin plus predentin differed considerably in width from animal to animal, as will be seen from the table. By dividing this width by that of the predentin laid down just before the animal was killed, an estimate could be made of the length of time vitamin D had been acting on the tooth. The figures so obtained varied from 4·2 to 6·5 days. It was assumed in this calculation that the daily increments of new dentin were equal in width to that of the new predentin. This assumption was supported by the fact that in the animal from which the figure of 6·5 was obtained, the new dentin showed six incremental stripes, which together with the predentin formed 24 hours before the animal was killed would indicate that the vitamin had acted on the tooth for seven days. These figures are on an average rather smaller than those obtained from bone by Morgareide and Manley[4], who found, using radioactive phosphorus, that rachitic metaphyses reacted 54–72 hours after dosage with vitamin D.

The depth of staining of the new dentin indicated that after ten days the D administered was still exerting a marked action.

INFLUENCE OF VITAMIN D UPON THE INCISOR TEETH OF RACHITIC RATS

Rat No.	Treatment	Width of new predentin (μ)	Width of new dentin and predentin (μ)	Days of dentin response	Degree of healing of rickets. (Line test)
1	31 days on rachitogenic diet. 9·2 I.U. of D on 21st day.	14	74	5·3	3·5
2		10	46	4·6	1·0
3		12	50	4·2	1·0
4		12	60	5·0	3·5
5		13	84	6·5	3·0
6		10	44	4·4	0
7	31 days on rachitogenic diet only.	—	—		0
8		—	—		0
9		—	—		0

Some correlation was noted between the width of new dentin plus predentin and the healing in the bones as measured by the line test (Dyer[5]). The widest reactive dentin was found in those rats that showed the highest degree of healing and the narrowest in those with little or no healing. It would thus appear that the tooth is more sensitive to the action of D than are the epiphyses and also that a time element enters into the degree of healing of bony rachitic lesions. It is possible that if rat No. 6 had lived longer, it might have shown some healing of the bones. It should be noted that the reaction of the dentin in all teeth, judged histologically, was equally intense whether it started early or late.

It is intended to develop these observations further in a study of the action of vitamin D.

J. T. IRVING.

Department of Physiology,
University of Cape Town.

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[1] Schour, I., and Ham, A. W., *Arch. Path.*, **17**, 22 (1934).

[2] Schour, I., Tweedy, W. R., Chandler, S. B., and Engel, M. B., *Amer. J. Path.*, **13**, 971 (1937).

[3] Irving, J. T., *J. Physiol.*, **99**, 8 (1940).

[4] Morgareide, K., and Manley, M. L., *J. Nutrition*, **18**, 411 (1939).

[5] Dyer, F. J., *Quart. J. Pharm. Pharmacol.*, **4**, 503 (1931).

Desorption or 'Surface Melting' of Lubricant Films

A RECENT communication[1] has described the effect of temperature on the lubricating properties of mineral oils. The apparatus used for the experiments was that devised by Bowden and Leben for analysing the frictional force between sliding surfaces. In this apparatus the bottom surface is driven steadily forward, but the upper surface is mounted on a bifilar suspension so that it has a certain degree of freedom and can respond to any changes in the frictional force. Using this apparatus they have shown that the sliding between steel surfaces lubricated under boundary conditions with certain mineral oils and with other lubricants may not be continuous but may proceed by a process of 'stick and slip'. In general, this jerky motion is observed with non-polar lubricants which are not adsorbed or are only weakly adsorbed on the metal surfaces. With certain polar molecules, such as the long-chain fatty acids which form strongly adsorbed layers, the motion changes over to continuous sliding. It was also found[2] that the polar oxidation products which may be present in solution in some mineral oils or which are formed in the oil by heating may act in a similar way and may cause continuous sliding. The experiments described in the previous communication[1] have shown that, if the surfaces are warmed, these adsorbed polar substances may be driven off the surface, and the motion may change over to stick-slip. This transition, which is a reversible one, may occur at quite moderate temperatures, for example, 50° C., and is accompanied by an increase in wear.

These experiments have been continued with a number of pure straight-chain hydrocarbons on steel surfaces. Some of the later measurements were made by Mr. J. J. Frewing. Bowden and Leben's observations[3] that *solid* films of saturated hydrocarbons or of straight-chain alcohols give continuous sliding and that the transition to stick-slip occurs *at the melting-point* have been confirmed. It was also found that *liquid* films of the fatty acids give continuous sliding and that this persists when the surfaces are warmed up. *When the temperature was raised to about 75° C. above the melting-point, however, the transition to stick-slip occurred.* The typical behaviour of a fatty acid is shown in F 1. These results are for lauric acid.

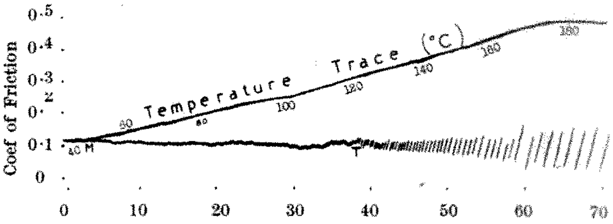

Fig. 1.

The upper trace records the temperature, and the lower trace the friction. It will be seen that at first smooth sliding occurs and the friction is reasonably constant, and there is no change at the melting-point (*M*). At the point *T*, however, the transition to stick-slip occurs. The effect was reversible and, on cooling down, the return to continuous sliding occurred at the same temperature. The measurements were made on a homologous series of fatty acids from pelargonic to stearic and the results are plotted in Fig. 2. Curve I gives the melting point of the samples used, and Curve II the temperature at which the transition from smooth sliding to stick-slip occurred. It will be seen that there is a separation between these curves which is nearly constant and is approximately equal to 75° C.

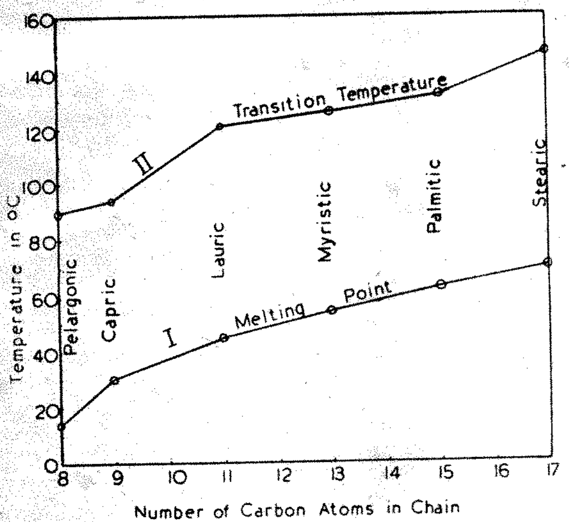

Fig. 2.

It is suggested that the transition from smooth sliding to stick-slip is due to the desorption or disorientation of the adsorbed film or to a change of state from a closely packed to a less closely packed form. The fact that this 'surface melting' of the adsorbed film occurs at a temperature 75° C. above the bulk melting point in the case of the acids, close to the melting point in the case of the corresponding alcohols, and at the melting point in the case of the corresponding hydrocarbons, is interesting. At the melting point of the bulk solid, sufficient kinetic energy is distributed among the molecules to enable them to overcome their attraction for one another. In order to melt the adsorbed film, sufficient energy must be available to overcome this mutual attraction plus their attraction for the surface. The difference between the transition temperature and the bulk melting point may therefore be regarded as a measure of the strength with which the polar group is attached to the steel surface.

The results suggest that this analytical frictional method provides a useful weapon for measuring the strength and for studying the mechanism of the adsorption of various polar groups on to solid surfaces. Apart from their theoretical interest, these observations are of considerable practical importance. If a lubricant contains suitable polar substances it will give smooth sliding and low wear at room temperature but, when the temperature is raised, the adsorbed film responsible for this may be driven off. The temperature at which this occurs may be below 100° C. and may be easily attained by many parts of a running engine. It is clear that this must be taken into consideration, both in the testing of a lubricant and in its selection for practical use.

I am indebted to members of Dr. Bowden's research team in the Laboratory of Physical Chemistry at Cambridge for helpful discussions and to the Petroleum Company for permission to publ work, which was carried out in their laborat

D. T

Britannia Laboratory,
Britannia Place,
Cambridge.

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[1] Tabor, NATURE, **145**, 308 (1940).

[2] Bowden, Leben and Tabor, *Trans. Faraday Soc.*, **35**, 900–9

[3] Bowden and Leben, *Phil. Trans.*, A, **239**, 1–27 (1940).

"The Man of Science as Aristo

IF I may say a word more about "The Man of as Aristocrat", I would like to point out to m Lieut.-Colonel Moore-Brabazon that my sug as Sir Richard Paget realizes, was of a aristocracy of the spirit in an entirely de world. I did not suggest that men of thou knowledge should rule or control anybody or outside the range of their distinctive gifts. I s that within that range they should refuse a to be directed, controlled or silenced by a that they should bear themselves like brain backbone, and not like flexible slaves.

H. G. W

13 Hanover Terrace,
N.W.1.

MR. H. G. WELLS[1] states that he was danger of becoming corruptingly rich by films, and that "Mr. Paul came along to me an out a provisional patent that would have practically the ground landlords of the en industry" (NATURE, April 19, p. 465).

My provisional specification described m presenting the main incidents in Mr. Well "The Time Machine". To create an ill travelling through time spectators were to on a rocking and oscillating platform and to wind and noise effects. Pausing at vario —past, present and future—they were to s priate events shown on a screen by means of photographs and dissolving views. It was t details of such scenes that I invited Mr. my office in Hatton Garden towards th 1895. He listened patiently to my propos his general approval to my attempting to c out, and proceeded to talk of subjects su the primeval scenes. Having recommende perusal some books on extinct monster without further discussion as to future ac many years elapsed before I had the pl meeting him again.

My scheme was promptly abandoned fo which can be guessed by those acquain animated photography in 1895. Then o films could be watched by individuals w through the slot of an Edison kinetoscope its variants. In several countries inventors, myself, were seeking means for showing screen, and such projectors came into us 1896. The simplest scenes, coupled with t of seeing photographs moving, sufficed to a public and to establish the new art of cinem in favour. A prolonged presentation, su of "The Time Machine", was then unnece indeed impracticable.

ROBT. W

High Street,
Sidford, Devon.

RESEARCH ITEMS

The Genitalia of Hymenoptera

The morphology of the external genitalia of male insects has received a good deal of attention in recent years, and one of the most active workers in this field is R. E. Snodgrass, of the U.S. Department of Agriculture. His most recent contribution to this subject deals with the male genitalia of the order Hymenoptera (*Smithsonian Misc. Coll.*, 99, No. 14, Washington, 1941, 86 pp., 33 plates). The author concludes, in regard to insects in general, that the primary genital ducts in the male must have opened on the tenth segment of the abdomen. Paired penes, giving individual exit to these ducts in Ephemeroptera and certain Dermaptera, appear to belong to this segment. The median genital organ of other insects is termed by Dr. Snodgrass the phallus, which is formed by the union of a pair of genital lobes arising, in most cases, on the ninth abdominal segment. The nature of the so-called claspers is fully discussed, and while it is conceded that these structures are derived from the phallus in some orders of insects, in others, including Heteroptera, Mecoptera, Trichoptera, Lepidoptera, and Diptera, he says that there is no conclusive evidence as to the nature of the movable claspers borne on the 'coxal plates' in the orders named. In the Hymenoptera the development of the phallus is from a pair of rudiments on the ninth abdominal segment. Characteristic genital features of the order are the lateral parameral lobes or 'valvæ externæ', a median œdeagus, a pair of volsellæ or 'valvæ internæ' and, in bees, the sagittæ or 'penis valves' in addition. All these components are derived from an original phallus, and include no counterparts of the claspers found in those orders listed above.

Incidence of Lice

An investigation has recently been carried out by K. Mellanby at the request of the Board of Education and the Minister of Health with the object of discovering the incidence of the head-louse in England. In a memorandum enclosed with Circular 2306 (Ministry of Health) and Circular 1544 (Board of Education), it is stated that infestation of the body is rare in children. As the result of an examination based on approximately 60,000 cases in hospitals, it is found that a very high degree of infestation with head-lice exists in industrial cities, and that girls are more frequently infested than boys. In industrial cities infestation in girls reaches a peak at three years old (51·6 per cent), and similarly in boys, but at the rate of 40 per cent. In the rural areas the percentage of children infested is very low. There is, it appears, no evidence that louse infestation, though widespread, is increasing. All the evidence points to the fact that education and improved social conditions have resulted in it being less common and less severe than in the past. The conclusion is reached that education of the public is the only method likely to yield permanent success. While local authorities have powers to take appropriate action, it must be premised that the desired improvement of conditions will be secured by a continuous use of administrative measures for treating cases which have arisen and by educational efforts rather than by resorting to powers of compulsion.

Frost Resistance in Plants

In the now voluminous literature on this subject it is evident that two physical factors in the organization of protoplasm are of importance in determining hardiness: the percentage of bound water and the permeability to water. Increase in either of these properties, or of both, is involved in increase in hardiness. Some light is thrown on the relation of these properties to hardiness by Siminovitch and Levitt (*Canadian J. Res.*, 19, 9; 1941) in an investigation of the physical properties of the protoplasm in several hardy and non-hardy species. The surface membrane of non-hardy cells stiffens when dehydrated osmotically and therefore ruptures readily when subjected to tension on deplasmolysis. This stiffening either fails to occur in hardy cells or arises as a result of much greater dehydration. The volume enclosed by the membrane can be reduced in these latter tissues to less than one third of its initial value without any sign of deplasmolysis injury, whereas in non-hardy cells a reduction to only two thirds causes death on deplasmolysis of more than 50 per cent of the cells. A further difference brought to light by these plasmolytic experiments is the clumping of plastids and granules (systrophy) in non-hardy but not in hardy species consequent upon prolonged immersion in a plasmolyticum. With regard to other physical properties, the refractive index of the protoplasmic surface increases more on dehydration in non-hardy than in hardy cells, and oil drops injected into plasmolysed cells readily become crescent shaped in non-hardy cells on deplasmolysis, but not so readily, if at all, in hardy cells. All these facts indicate a greater hydrophily in hardy than in non-hardy species both of the surface membrane of the protoplasm and, possibly to a lesser extent, of the protoplasm as a whole. This is obviously in harmony with the above-mentioned views concerning bound water and permeability.

Lily Mosaic

The ninth volume of the Royal Horticultural Society's Lily Year Book (from the Society's office, Vincent Square, Westminster, S.W.1; 1940, 5*s*. paper, 6*s*. cloth) contains a useful review by D. E. Green and M. A. H. Tincker of the damage caused to lily plants by the mosaic virus. Many species of the genus Lilium frequently show the characteristic leaf mottling symptoms of the disease, which usually destroys a stock within three or four years. Malformation and dwarfing of the flowers is also found, with diminution in size of the bulbs. The malady is distributed by the insect vector *Aphis gossypii*, which can be largely controlled by frequent application of nicotine dust. Infection by the virus often occurs in the seedling stage, though the disease is not truly seed-borne. *Lilium speciosum* and *L. auratum* were the host species particularly studied, and stocks of the former survived for a longer period at Wisley than did the latter, which is very susceptible.

Rust-Resistant Antirrhinums

D. E. Green reports progress on the selection of strains of Antirrhinum resistant to the rust fungus *Puccinia Antirrhini*, in a recent short paper (*J. Roy. Hort. Soc.*, 66, Pt. 3; 1941). Resistant forms were obtained from the United States, but were not florally desirable; the problem was first to select a series of parent forms with flower colours suitable for decorative combination. This has now been accomplished, and five rust-resistant strains of varying flower colour have been established. It is not yet known if they are resistant to a second physiological race of the parasite which has appeared in the United States.

Trisomics in Nicotiana

T. H. Goodspeed and P. Avery (*Proc. U.S. Nat. Acad. Sci.*, **27**, 13–14; 1941) have found the twelfth primary trisomic in *Nicotiana sylvestris* ($n = 12$). This trisomic, Stiff, has extremely long flowers and stiff leaves which easily distinguish it from the diploid and the other eleven known primary trisomics. Stiff arose from the cross $3n - 1 \times 2n$ as a double trisomic with Puckered. This in turn gave 24 diploid, 12 Puckered, 14 Stiff and 3 double trisomics. Stiff has also arisen from the progeny of an asynaptic form of the trisomic Inflated.

Determination of Arsenic

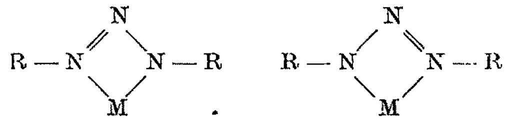
At a meeting of the Society of Public Analysts and other Analytical Chemists held on February 5 H. J. G. Challis described the interference of selenium and tellurium with the determination of arsenic by the hypophosphorous acid method. In the method of B. S. Evans for the determination of arsenic by separation with hypophosphorous acid and subsequent iodimetric titration, if selenium or tellurium is present errors are caused inasmuch as these elements also are precipitated by hypophosphorous acid and are oxidizable by iodine. To avoid these errors a modification of the method is described in which the hypophosphorous treatment is carried out first at 50° C. for half an hour. This precipitates selenium and tellurium but not arsenic, and after filtration the arsenic is precipitated from the filtrate at boiling temperature as described by Evans.

Underground Water Supply of Calcutta

An inquiry from the Corporation of Calcutta as to the nature of the strata below the Gangetic delta, arising from a proposal to install deep tube-wells, led to the preparation by A. L. Coulson of Water Supply Paper No. 1 (*Mem. Geol. Surv. India*, **76**, 150; 1940) which contains a systematic account of all the relevant information. After a general description of the Indo-Gangetic plains and the Ganges delta, the question of the maximum thickness of the alluvium and the discrepancy between the geological evidence and that afforded by geodetic observations is discussed. Theories are given for the origin of the 'swatch of no ground' off the Ganges delta. Detailed information gained from the sinking of tube-wells in Calcutta and its vicinity during the last 135 years is compiled. It is pointed out that the rate of flow of the underground water is slow and that considerable mutual interference must be expected between wells sunk too close together. As to the sources of the water, it is concluded that while there is a south-easterly flow from the Damodar river, the bulk of the underground supplies is replenished by slow southward percolation from the Brahmaputra and Ganges. It is pointed out that there is some danger of exhausting the supplies if numerous wells are sunk to tap the aquifers. It is recommended, however, that an experimental tube-well boring should be sunk to a depth of 5,000 feet or less, according to whether or not the basement rocks underlying the Gangetic alluvium are encountered before that depth is reached. A gradual coarsening of the beds with depth is expected, until the Tertiary marine strata or the Supra-Panchet rocks are struck. It is the gravel beds—if these are proved to exist—immediately overlying the basement rocks that will most likely furnish water under artesian conditions.

Metallic Triazine Complexes

The preparation of a number of metallic salts of diazoamino compounds and the determination of their molecular weights, by F. P. Dwyer (*J. Amer. Chem. Soc.*, **63**, 78; 1941) show that they should be formulated as inner complex salts in which the triazine group functions as a chelate (2-co-ordinating) group, and with the possibility of resonance (leading to stability) between the two structures:



Two compounds prepared appear to be the first examples of hexacovalent palladous compounds described, the triazine groups being probably octahedral about the metallic atom in *cis* positions. F. P. Dwyer and D. P. Mellor (*J. Amer. Chem. Soc.*, **63**, 81; 1941) by magnetic susceptibility measurements show that nickel complexes of diazoaminobenzene and 4-4′-dimethyldiazoaminobenzene are diamagnetic and hence in them the nickel atoms have a square co-ordination configuration. In that case the triazine group appears to function as a chelate group. Molecular weight determinations show that two deep red diamagnetic complexes are dimeric in benzene; on boiling, this structure gradually breaks down into the monomeric form, the change being reversed on cooling. The dimeric forms involve an 8-membered ring of nitrogen atoms bridging the nickel atoms which is very unusual, although there is evidence for its occurrence with *bis*-ethylenediamine cobalt complexes with sulphonyl diacetic acid and with homophthalic acid.

Crystal Structure of Iodic Acid

An X-ray examination of the structure of the α-modification of crystalline iodic acid by M. T. Rogers and L. Helmholz (*J. Amer. Chem. Soc.*, **63**, 278; 1941) shows the presence of discrete pyramidal IO_3' groups in the crystal with the observed I–O distances 1·80 A., 1·81 A., and the O–I–O angles 96°, 98° and 101°. Three oxygen atoms in positions approximately opposed to the three-bonded IO_3 oxygens and at distances 2·45, 2·70 and 2·95 A. complete a distorted IO_6 octahedron with three strong bonds and three weaker ones. The hydroxyl oxygen atom of each iodate group has two nearest oxygens at 2·78 A. There are thus two hydrogen bonds for each iodate group forming a moderately strong bifurcated bond. The oxygen atoms are in a somewhat distorted closest packed arrangement and the structure somewhat resembles that of perovskite. Crystalline iodic acid is an aggregate of HIO_3 molecules held together by hydrogen bonds, and secondary I–O bonds of the type observed for arsenic and oxygen in arsenolite.

Stability of Crystal Lattices

IN the fifth of a series of papers, R. Fürth (*Proc. Camb. Phil. Soc.*, **37**, 34; 1941) deals with the relation of some experimental results and recent theories of the equation of state and the melting of solids. After a short survey of Born's theory of the thermodynamics and melting of crystals it is shown that Lindemann's and Grüneisen's law for the normal melting temperature can be deduced. Values in good agreement with experiment are got for the dependence of the melting temperature on pressure and for the dependence of the compressibility and elastic constants on pressure and temperature. Several connexions between breaking and melting, suggested by the fundamental ideas on melting and stability of crystals, are discussed and verified. A relation between heats of melting and of sublimation gives values of the correct order of magnitude (see also NATURE, **145**, 741; 1940).

Reagent of Aldehydes

A 1 per cent solution of N,N-dibenzyl-*m*-phenylenediamine in 95 per cent alcohol is proposed as a reagent for aldehydes by F. G. Singleton and C. B. Pollard (*J. Amer. Chem. Soc.*, **63**, 240; 1941). The test is carried out by placing two drops of the substance in a test-tube and adding 5 ml. of the reagent. Saturated aliphatic aldehydes give a red initial colour followed within ten minutes by a bright green fluorescence which becomes stronger on standing; formaldehyde is exceptional in giving a yellow initial colour and no fluorescence. Unsaturated aliphatic aldehydes give a darker red initial colour than saturated, and a dull brownish-green fluorescence appears within ten minutes; hexadiene-2,4-al and cinnamaldehyde show unusually dark red initial colours but no fluorescence. Aromatic aldehydes give initial colours which vary from bright yellow to dark red, and a bright green fluorescence appears only after two or three hours.

Long-Chain Polar Compounds in Lubrication

THE effect of long-chain polar compounds on the coefficient of kinetic friction under boundary conditions has been studied by O. Beeck, J. W. Givens and A. E. Smith (*Proc. Roy. Soc.*, A, **177**, 90; 1940). The Boerlage four-ball friction apparatus in various modifications was used, and the structure of thin films of lubricants rubbed on polished mild steel surfaces was examined by electron diffraction. For oils which showed high surface orientation imparted by addition of long-chain polar compounds, a sudden decrease of the coefficient of friction was observed at various velocities of the sliding surfaces, depending upon the compound used. Those compounds in which the effect occurred at the lowest velocities were found to be most highly oriented with their carbon chains most nearly perpendicular to the surface. At the regions of sudden decrease of the coefficient of friction the electrical resistance between the sliding surfaces changes from a low value, corresponding to metallic contact, to an extremely high value. The effect is explained as a 'wedging' of oil under the surface.

The Ellipticities of the Earth and Moon

JEFFREYS has recently combined six data relevant to the ellipticities of the earth and moon and found the agreement satisfactory (*Mon. Not. Roy. Astro. Soc.*, 101, No. 1; 1941). These are the secular motions of the node and perigee, the monthly term in the moon's latitude, the inclination of the moon's axis, the annual libration in longitude and a new determination of the ellipticity term in gravity recently made by Jeffreys himself. Following work by Brown and Spencer Jones, and using Belkovitch's solution concerning f in preference to that of Franz and Stratton, Jeffreys obtains:

$$J = 0{\cdot}0016377 \pm 0{\cdot}0000042\ (0{\cdot}0000062\ s.e.)$$

giving $\frac{1}{\varepsilon} = 297{\cdot}05 \pm 0{\cdot}38$ (0·56 *s.e.*). This value has about the same apparent accuracy as Heiskanen's and the international gravity formula (Potsdam standard) is modified to

$$g = 978{\cdot}049\,(1 + 0{\cdot}0052895 \sin^2\varphi - 0{\cdot}0000059 \sin^2 2\varphi).$$

It has been suggested by Browne and Bullard that the first factor should be 978·032 but that the change should not be made until the connexions between Potsdam, Cambridge and the National Physical Laboratory have been strengthened. According to Jeffreys the constants for the moon are now:

$$J + \tfrac{1}{2}K' = 0{\cdot}0003733 \pm 0{\cdot}0000011\ (0{\cdot}0000016\ s.e.)$$
$$K' = 0{\cdot}000073 \pm 0{\cdot}000023\ (0{\cdot}000034\ s.e.)$$
$$f = 0{\cdot}804 \pm 0{\cdot}062\ (0{\cdot}092\ s.e.)$$

An outstanding difficulty is still the disagreement between the moon's dynamical and visual parallaxes, which Jeffreys suggests may be due to an abnormal deflection of the vertical at Cape Town.

The Ellipticity Term in Gravity

JEFFREYS has recently made a new estimate of the main ellipticity term in gravity (*Mon. Not. Roy. Astro. Soc.*, Geophys. Supp., **5**, No. 1; 1941). Taking the existing observations of gravity over the surface of the earth, forming summaries of the free air anomalies over 10° squares and reducing to the mean height of the square so as to eliminate the correlation of the free air anomaly with height, it was hoped to determine the harmonics of low order other than the main ellipticity term. It was found that the observations were unsuitably distributed for such a determination owing chiefly to lack of data for the South Pacific and high southern latitudes, but they did yield a new estimate of the main ellipticity term in gravity. This ellipticity turned out to be the reciprocal of 296·80 ± 0·71.

Diffuse Radiation in the Galaxy

THE so-called interstellar 'absorption' of light which gives rise to the dark nebulæ is likely to be (at least in part) scattering rather than absorption. This being so, those regions of the Milky Way rendered least luminous to the naked eye because the light of distant stars is absorbed should show a faint background of diffuse light due to scattering by the interstellar particles. This has been recently verified by Henyey and Greenstein (*Astrophys. J.*, **93**, 70; 1941), who used for the purpose a Fabry photometer attached to the 40-in. refractor of the Yerkes Observatory. Surface brightnesses of the sky were measured photographically across the Milky Way at several points, choosing fields free from stars brighter than mag. 16 so as to reduce the correction for unresolved starlight. After correcting for the light of faint stars, for direct and scattered auroral light, and for zodiacal light, these observations indicate a diffuse radiation concentrated closely to the galactic equator and reaching there a value equivalent to some 60 tenth-magnitude stars per square degree; more in the dark regions, less in the transparent areas. This diffuse light can be explained as scattered stellar radiation if the phase function governing the scattering is strongly forward-throwing.

MEASUREMENT OF ATMOSPHERIC OZONE BY A QUICK ELECTROCHEMICAL METHOD

BY PROF. F. A. PANETH AND DR. E. GLÜCKAUF

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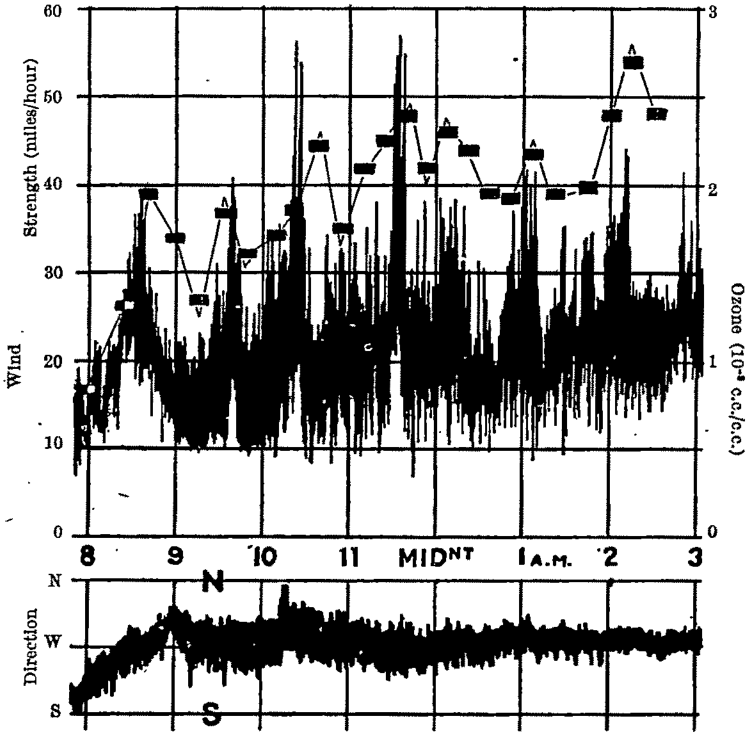
AT a conference held at Oxford in September 1936 the need for a chemical method of determining atmospheric ozone, and the objections against those applied so far, were discussed[1]. Two years later a procedure was described which avoided the earlier drawbacks: by condensing ozone on cooled silica gel it was possible to reach a concentration sufficient for safe identification by specific reagents and absorption spectrum, and for a reliable titration[2]. The process is, however, cumbersome, and the hope was expressed that, after establishing this trustworthy method by which to test others, a much simpler one might be found sufficiently exact for meteorological purposes[3].



The method described here seems to meet this requirement; it is at the same time very fast and continuous and lends itself to automatic recording. Its main features are: (1) the atmospheric ozone is absorbed in a potassium iodide solution under conditions which exclude wall reactions; (2) the liberated iodine is measured by its depolarizing effect on platinum electrodes; (3) the periodic addition of constant quantities of thiosulphate restores the initial conditions and makes it possible to take ozone readings every two minutes or so, unless the atmospheric ozone concentration is much below average.

The course of the chemical reaction between ozone and iodide is influenced by the presence of a glass surface; this heterogeneous reaction is responsible for the production in neutral solutions of iodate, besides iodine, and for the catalytic decomposition of part of the ozone[4]. In our apparatus the air enters at high speed through a nozzle, thereby spraying potassium iodide solution vigorously throughout the reaction vessel and bringing ozone and liquid in close contact without interference of the glass walls. The reaction of ozone with the fine spray of buffered neutral solution is found to be quantitative even at concentrations as low as 10^{-8} c.c. of ozone per c.c. of air, and is apparently entirely homogeneous, as no iodate is formed. The sprayed liquid is collected and, by the suction of the nozzle, circulated back to the inlet tube; on its way it flows rapidly over two platinum electrodes having a potential difference of 10 mv. An electric current can pass only if the cathode is depolarized by an oxidizing agent[5]; free iodine of less than a millionth normality permits the passage of currents easily measurable by a galvanometer. This apparatus achieves the absorption of ozone from air, passing at the rate of about 1,000 litres per hour, with 15 c.c. of potassium iodide solution; the evaporating water is replaced by using a highly diluted (*N*/2,000) solution of thiosulphate for titration.

We have tested the reliability of the new method by carrying out a parallel determination with the condensation method by which ozone is separated from nitrogen dioxide[2]. It was found that there was no nitrogen dioxide present, and the ozone values agreed within 2 per cent. Moreover, tests have shown that, under the conditions of our procedure, nitrogen dioxide liberates very little, if any, iodine from a neutral potassium iodide solution; thus the method is practically specific for ozone.

We hope to employ the method for a systematic study of the occurrence of ozone in the troposphere and lower stratosphere. So far we have investigated its dependence on the intensity and direction of local winds. More than seventy years ago a connexion between ozone concentration and wind was announced[6]. It was rediscovered several times[7]; quite recently the application of a micro-method[8], based on the principle of passing air over, instead of through, a potassium iodide solution[9], rendered it possible to follow fairly quickly the effects of wind changes[10]. We made use of our faster and simpler method, and of the facilities offered by the University Observatory—situated about one mile to the south-west of Durham

City—to compare closely ozone and anemometer readings taken on the same spot.

It was found that winds from the north-east, coming from Durham City, never contained ozone; on the contrary, our apparatus showed the presence of reducing substances (probably sulphur dioxide from burnt coal) which were not detectable—even after destruction of ozone with active charcoal—in westerly winds. These winds, if exceeding 5 miles per hour, nearly always contained ozone. Stagnant air had none, but showed reducing qualities. The parallelism between ozone content and wind velocity was most impressive on days with heavy gusts of westerly wind. The accompanying figure is a reproduction of the Dines anemometer record for the night of December 5/6, 1940, on which the ozone values are inserted (the length of the markings indicates the duration of the measurements); it can be seen that every ozone maximum follows closely on a series of high gusts, a time lag of a few minutes being noticeable.

The reality of such a time lag—easily understandable—was also clearly shown when the wind suddenly, and for a considerable time, changed its direction (see the following table giving anemometer and ozone values for March 21, 1941). It took several minutes before the ozone-containing air masses had been swept away after sudden veering of the wind to the north-east.

Time Interval G.M.T.	Direction	Wind Velocity (miles/hr.)	Ozone content (in 10^{-8} c.c./c.c. air)
10.31 to 11.10	W.N.W.	20 to 15	3·6, 3·0, 3·1, 2·8, 3·6, 2·9, 2·9
11.10 ,, 11.13	sudden change to N.E.		2·3
11.13 ,, 11.17	N.E.	15 to 12	3·6, 3·1
11.17 ,, 11.19		12	rapid fall to $< 0 \cdot 1$
11·19 ,, 11.45		12 to 10	$< 0 \cdot 1$

There are, however, observations which indicate changes others than those due to local contamination. Early during the depression of December 5, 1940, the ozone concentration decreased from $2 \cdot 1 \times 10^{-8}$ to zero more than two hours before the thermograph showed the arrival of a warm front, the wind being south-south-west the whole time, and even gaining in strength; the quick rise of the ozone to $1 \cdot 9 \times 10^{-8}$ at 8.40 p.m. (visible in the figure) was accompanied by a turning of the wind to west and closely followed by the passage of a cold front. Similar observations were made during depressions on November 20 and 27 and December 10. Such measurements, if carried out in regions free from artificial contaminations, may be as helpful for the study of large-scale turbulence in the troposphere[11] as that of 'ozone clouds'[12] in the stratosphere. Another fact already emerging from the data collected is an increase of about 100 per cent in the average ozone content from November 1940 to March 1941; this constitutes an obvious parallelism with the spectrographic measurements of the total ozone in the atmosphere[13] and thus seems to confirm the views about a correlation between tropospheric and stratospheric ozone[14].

A fuller description of the procedure and results will be published later.

We desire to express our thanks to the Department of Scientific and Industrial Research for a grant; to the curators of Durham University Observatory for providing facilities to work there; and to Mr. P. R. Monk for his help in preliminary experiments carried out in 1939 at the Imperial College in London.

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INFLUENCE OF GEOLOGY ON THE HEALTH OF GRAZING ANIMALS

By Dr. George Dunlop and Dr. W. J. McCallien

A SURVEY has been made in south-west Scotland of the distribution of vinquish, a debilitating disease of sheep referred to by Aiton in 1810 as being prevalent in this area. The disease shows certain affinities to coast disease of South Australia (1), wasting disease of Western Australia (2), bush sickness of New Zealand (3), nakuruitis of Kenya (4), moor cling of Devon (5), pining of the Scottish borders (6), salt sickness of Florida (7), pine of the Hebrides (8), and neck ail of Massachusetts (9).

The geological features of the areas on which these deficiency diseases occur are varied but can be grouped as follows: (*a*) æolian deposits of sand and comminuted shell fragments (1, 7, 8, 9); (*b*) granite and other igneous intrusions and lavas (2, 3, 4, 5); (*c*) areas geologically complex (6).

Following the work of Marston and his colleagues[10], it was shown that the daily administration of small amounts (< 1 mgm.) of cobalt quickly cured animals suffering from certain of these maladies (2, 3, 4, 5, 6), copper as well as cobalt was essential for the cure of (1), iron and copper for (7), and iron alone for (8, 9). In curative experiments on vinquish a daily dose of 40 mgm. iron + 10 mgm. copper was administered to 16 animals, of 10 mgm. copper to 17 animals, and of 1 mgm. cobalt to 21 animals. Cobalt alone was effective, all the animals recovering quickly from the disease. It appears, therefore, that vinquish in our area is a straight cobalt deficiency.

The accompanying diagram (Fig. 1, below) illustrates the distribution of vinquish in south Ayrshire. Comparison of this diagram with the geological sketch-map (Fig. 1, above) at once suggests a fairly close relationship between the disease and the geology of the region. The exact nature of this relationship is not yet known, but it is worth considering at this stage of the investigations.

The Southern Uplands Fault is the most conspicuous structural feature of our area. The sharp division of vinquish from non-vinquish grazings along the line of the fault may be illustrated by the following examples :

(*a*) Vinquish is unknown on farms with the fault as their northern march.

(*b*) Farms with the fault as their southern boundary are affected.

(*c*) Where the farm extends across the fault the hefts to the north are affected and those to the south are clear. (A heft is a group of sheep—usually 3–8 score—grazing together within natural boundaries.) Near the head of Loch Doon, a hirsel, comprising four hefts, stretches across the fault. On the most westerly heft there is only a small proportion of ground to the north of the fault, but this proportion increases with each heft until on the most easterly the grazing is largely on the north side. Cases occur sporadically among the first lot of ewes, but the number of affected sheep increases on each heft to the east until the most easterly is regarded as bad pining ground.

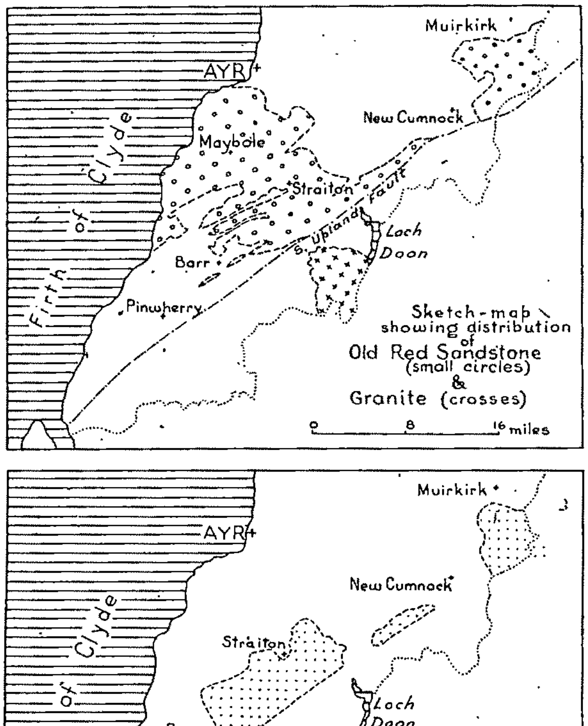

Fig. 1.

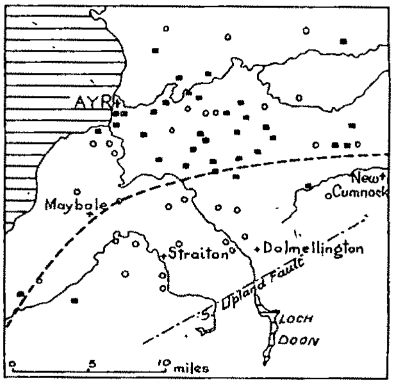

Fig. 2.

DRIFT AND MINERALOGICAL SKETCH MAP OF SOUTHERN AYRSHIRE.

Heavy broken line : boundary between northern and southern drifts. Black rectangles : soil carrying more than 2·9 per cent heavy crop. Circles : soil carrying up to 2·9 per cent heavy crop. Based on Elder and McCall.

In the area at present under review the Southern Uplands Fault separates the Upper Palæozoic rocks of the Midland Valley from the Lower Palæozoic of the Southern Uplands. The Upper Palæozoic consists chiefly of Old Red Sandstone sediments, andesitic lavas, and intrusions. These all support vinquish grazings, but the disease is most severe on areas of felsite and related intrusions.

The northern boundary of the vinquish areas is defined partly by the appearance in this direction of arable farms. Where hill sheep farms exist the grazings to the north of the dotted areas in Fig. 1, below, are free from vinquish.

The northern boundary appears to coincide with the junction of the drifts of northern and southern origins as determined by the Geological Survey. The difference in the mineralogical composition of these drifts is marked. Mineralogical analyses by Elder and McCall[11] have shown that the ferromagnesian crop from the soils on the northern drift average 4·6 per cent, while on the southern drift the percentage is invariably lower (Fig. 2). It is noteworthy that the soils from the vinquish farms of Auchenroy, Shaws Knowe, Grimmet, and Straiton Moor contain the lowest percentage of ferromagnesian minerals—1 per cent or less.

From what has been said above it seems that there is a close connexion between the geology and the health of the grazing animals and that the Southern Uplands Fault in the region studied in greatest detail (Tairlaw and Knockdon) forms the demarcation between the vinquish-affected and the healthy areas. Field study suggests that the differences in the solid geology are not entirely responsible. Considerable tracts of Old Red Sandstone in the Straiton region are composed of andesitic lavas relatively rich in iron and, therefore, presumably also in cobalt. In the area south-east and east of Barr the rocks on the two sides of the Southern Uplands Fault are the same, yet the vinquish map shows the same contrast between vinquish and healthy districts as in those parts where the Old Red Sandstone occurs on one side of the fault and the Lower Palæozoic on the other. We have come to the conclusion, therefore, that the nature of the drift is largely responsible for the incidence of the disease.

In general, the Southern Uplands Fault separates a mountainous belt from the comparatively low ground of the Midland Valley. The difference in topography, a conspicuous feature in the landscape of the Knockdon area, may in itself be a factor bearing on the present problem. It has at least been responsible for the restriction of the morainic drift to the country south of the fault and of the boulder clay to the more fertile ground to the north. The boundary between the two types of drift does not actually coincide with the outcrop of the fault, but the disease boundary line may not really coincide any better. One reason behind the distribution of the disease may, therefore, be the physical state of the subsoil, for the two types just mentioned, morainic drift and boulder clay, have been derived from the same parent rocks to the south.

The occurrence of vinquish on the felsitic outcrops indicates that in certain cases in our area there is a direct relationship between rock, subsoil, soil, herbage and morbid condition of the grazing animals.

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WHAT IS A PHYSICIST?

DURING the War of 1914–18 a physics student applied for postponement of military service to enable him to sit for his university examination. One member of the tribunal asked if the student would not be better occupied at a base hospital. Nobody saw the connexion until two words of explanation were given—"mixing physic". At the same time rumour had it that certain physicists working on radio-telegraphy were described officially as chemists because the Services had not officially heard of the term physicist. More recently the literature of popular science has helped to spread the idea that a physicist is essentially a splitter of atoms. In a leading article in the November number of the *Journal of Applied Physics*, published by the American Institute of Physics, fears are expressed that the services of physicists are liable to be neglected because service and business officers are still under the impression that physicists "being only interested in atoms" cannot be expected to be of much assistance.

The definition given by the Institute of Physics in Great Britain to the Ministry of Labour and National Services' Central Register was as follows: "A Physicist is one who has knowledge of, and experience in, one or more branches of physics. Physics includes the study of (1) the properties and nature of matter, (2) heat, (3) light (optics), (4) sound (acoustics), (5) electricity, (6) magnetism, (7) radio-activity; and their applications. *Note.* The technical application of certain branches of physics have become branches of engineering." With the Schedule of Reserved Occupations, the Ministry of Labour and National Service uses the definition: "*Physicist*—is engaged in the study of matter and its general properties as affected by the application of various forms of energy; may be specialized, e.g., in mechanics, heat, light, sound, electricity, radio-activity; the usual qualification is membership of the Institute of Physics and/or a University degree."

When the order for compulsory registration was made in July 1940 any person was considered a physicist who possessed an honours degree in physics of any university of the British Empire, and who was normally engaged as a physicist at any university or in any industry or as a teacher of physics. The number registered under that order was 1,175. Previously, 1,596 persons had registered voluntarily as physicists. Not only in Great Britain is there a scarcity of physicists. In the United States, according to an announcement in the February number of the *Review of Scientific Instruments*, the U.S. Civil Service Commission had to extend the closing date for receipt of applications for entry to the civil service examinations for physicists. The salaries attached to the posts were: physicist (any specialized branch), 3,800 dollars a year; principal, 5,600 dollars; senior, 4,600 dollars; associate, 3,200 dollars; and assistant, 2,600 dollars a year.

The difficulties of creating physicists when they are wanted for work in applied physics is perhaps difficult to realize for those who claim to be able to make a soldier from a civilian by giving him ten weeks' training. In its twenty years of life the Institute of Physics in Great Britan has worked hard in urging the importance of physics in industry. This work of national importance has had to be carried out at the cost of members of the Institute. That such work places a severe strain on the resources of the Institute is clear from the difficulties of the American Institute of Physics. Details of the help given by the Chemical Foundation to get the Institute safely launched were given in the thirteenth number of the *Rheology Leaflet*. When the help ceased, a deficit of 21,845 dollars had been accumulated by December 1937. In 1939 this had been reduced to 12,840 dollars. Now the Rockefeller Foundation has generously helped. In the same number of the *Review of Scientific Instruments* it is reported that "a drastic decline in foreign dues and subscription income caused by the War in Europe has now threatened to cancel the gains which have been made. In response to the Institute's appeal on this account, the Foundation has generously granted the sum of 20,000 dollars to assist the Institute to adjust the publication program to the new circumstances." In the preparation for, and prosecution of, wars the nations seem to have no difficulty in finding huge sums of money. Yet the bulk of research is still carried on by the aid of charity. The dearth of physicists and the financial difficulties of publication are not therefore surprising. On consideration, it is an odd state of affairs that the publication of scientific work benefiting, or at least used by, the whole world should still be paid for largely by the research workers themselves through their subscriptions to scientific societies.

BANANA FERTILIZER INVESTIGATIONS IN JAMAICA

INVESTIGATIONS of the effect of fertilizers on bananas are few in number, particularly in the great producing areas in the Caribbean region. In Jamaica, where many estates have been long under cultivation, and where Panama disease and soil erosion are tending to force cultivation on to new areas of lower fertility, a full knowledge of fertilizer requirements is rapidly becoming of paramount importance. The results of recent investigations by Croucher and Mitchell (*Bull.* 19, Dept. Sci. and Agr., Jamaica, 1940) are of both theoretical and practical interest, touching as they do on several aspects of the growth requirements of the Gros Michel banana.

The experiments under discussion were begun in 1932, but a succession of hurricanes and droughts prevented the reaping of several of the earlier crops, affording, incidentally, some impression of the difficulties with which the tropical investigator has to contend. The experiments undertaken were of a qualitative type, designed to give information on the general reaction of the banana to applications of the main plant nutrients. In the four different areas selected for experimental plots, different results were obtained: in one a growth response was obtained from nitrogen applications alone; in a second, response was obtained only when potash was applied, but phosphate improved production in the presence of potash; on the other hand, excess phosphate in the absence of potash adversely affected the quality of the fruit produced; in a third area, response was obtained only when phosphate was applied, but, in the presence of this nutrient, further response resulted from applications of potash and nitrogen; in a fourth area, absence of potash precluded the possibility of obtaining commercial fruit.

This brief statement of some of the results so far obtained indicates the wide and useful field that awaits further exploration. The assessment of yield of bananas is not a simple matter, in that it involves a consideration of (*a*) the number of 'hands' per bunch, (*b*) the quality of the individual fruits, (*c*) the rate of production, and (*d*) the population of plants per acre. In some areas nitrogen applications produced an increase in the length of individual fruits—a desirable commercial feature; in others, applications of nitrogen and phosphate also increased the length of fruits, whereas adverse results were obtained elsewhere; potash applications tended to offset undesirable effects resulting from phosphate fertilizers.

FORTHCOMING EVENTS

[*Meeting marked with an asterisk is open to the public.*]

Monday, May 19

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Dr. Hugh Scott, F.R.S.: "Highlands of Central Ethiopia".

Tuesday, May 20

ROYAL INSTITUTION OF GREAT BRITAIN (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Sir Joseph Barcroft, F.R.S.: "The Development of Function in the Mammalian Organism".*

Saturday, May 24

LINNEAN SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Anniversary Meeting.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

MAINTENANCE ENGINEER by the British Guiana Government Transport and Harbours Department—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9393).

ASSISTANT ENGINEER for the Government Federated Malay States Railways—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9618).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Liverpool Observatory and Tidal Institute. Annual Report, 1940. Pp. 12. (Birkenhead: Liverpool Observatory.) [284

How to Make Good Silage: an Illustrated Guide for Dairy Farmers. Pp. 32. (Nottingham: Boots The Chemists.) [15

Tin Research Institute. Publication No. 103: Report for 1940, summarising Recent Researches and Developments in the Uses of Tin in Industry. Pp. 24. Publication No. 104: Protective Films on Tinplate by Chemical Treatment. By Dr. R. Kerr. Pp. 14+4 plates. (Greenford: Tin Research Institute.) [15

South-West Essex Technical College and School of Art. Annual Report, Session 1939–40. Pp. 52+12 plates. (London: South-West Essex Technical College and School of Art, Walthamstow.) [15

Proceedings of the Royal Society of Edinburgh. Section B (Biology), Vol. 61, Part 1, No. 3: The Structure of Tulach Hill, Blair Atholl, Perthshire. By Dr. William J. McCallien. Pp. 43–54. (Edinburgh and London: Oliver and Boyd.) 1*s.* 6*d.* [15

Other Countries

Southern Rhodesia Geological Survey. Short Report No. 34: Geology and Mines of the Mashaba District. By R. Tyndale-Biscoe. Pp. 8. (Salisbury: Geological Survey.) [244

Gold Coast Colony. Report on the Forestry Department for the Year 1939–40. Pp. 8. (Accra: Government Printing Department: London: Crown Agents for the Colonies.) [284

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 136: Experimental Studies of Ephemeral Fever in Australian Cattle. By I. M. Mackerras and M. J. Mackerras; with a Section in collaboration with Dr. F. M. Burnet. Pp. 116+2 plates. Bulletin No. 137: A Soil Survey of the Red Cliffs Irrigation District, Victoria. By G. D. Hubble and R. L. Crocker. Pp. 63. (Melbourne: Government Printer.) [284

New Zealand Air Department. Meteorological Observations for 1939. Prepared in the Meteorological Office, Wellington. Pp. 39. (Wellington: Government Printer.) [284

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 200: Investigation on the Mechanism of the Cementation of Metals. By the late Masaji Goto, Hirosi Asada and Tuneyosi Okamoto. Pp. 429–476. 90 sen. No. 201: Studies on the Subsonic Flow of a Compressible Fluid past an Elliptic Cylinder. By Susumu Tomotika and Kō Tamada. Pp. 477–552. 1.05 yen. No. 202: Acoustical Studies of the Flutter of an Airscrew (Experiments with Actual Airscrew) (Investigations of Airscrew Flutter, Part 2). By Jûichi Obata, Major Yûzô Matumura, Ryô Kanayama and Yahei Yosida. Pp. 553–590. 70 sen. No. 203: On the Mechanism of a New Transformation, and some Associated New-Reactions in the Iron-Nickel Aluminium System. By Syûiti Kiuti. Pp. 591–720. 2.60 yen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) [15

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REGIONALISM IN ADMINISTRATION

THE extension of rationing, the concentration of industry, the changes in reserved occupations, and the registration of women must have brought home to everyone the vital part which the civilian population has to play in the present struggle; but that contribution must be seen in its true perspective. Whether in offence or defence, the striking power of the armed forces depends upon the maintenance of supplies. That is not a matter for the armament factories alone; it involves also the agricultural worker and others concerned with food production, and those who operate the transport services and other essential services in our industrial and national life. It is for the Government to determine as wisely as possible the exact balance between the distribution of man-power in the armed forces, munitions and other essential services for maintaining the national life, and this the policy of concentration and limitation of supplies is designed to promote. Once that balance has been struck, the development of full fighting power depends primarily upon maintaining health and morale and the maximum efficiency. Enemy air attacks on Great Britain have been directed as much against health and morale as against production.

Political and Economic Planning (P E P) has recently issued a valuable broadsheet entitled "London under Bombing", which directs attention not only to important specific issues but also to the wider problems involved in the readjustments of its life that the civil population is being compelled to make, and it does not fail to point out that in this greater plasticity lies one hope of the emergence of a better order. Artificial administrative boundaries, especially between the various parts of a single large town or urban cluster, can no longer be maintained. Regional organization of local services is gaining strength, and local organization is losing it. The whole-time administrator responsible to a higher authority is replacing the spare-time committeeman responsible to voters who may or may not vote occasionally either for or against him. The rigidity of class barriers has been diminished in the armed forces, in civil defence services, through evacuation schemes and otherwise, and the lack of balance between the material and the spiritual values of civilization has been sharply redressed. The nation has learnt that a vigorous social purpose is not only a source of satisfaction but also a source of strength and comfort.

Contrasting the experience of bombing with anticipations, the broadsheet refers to the way in which some technical surprises have played a part in determining the nature of London's problems during the last few months. The extensive use of the delayed action bomb has resulted in some unexpected transport problems due to traffic diversions, and in large numbers of temporarily homeless persons. It has also shown that bomb disposal squads were understaffed. Bombing has also stressed not only weaknesses in the civil defence services but also weaknesses in the whole system of the government of London. The existence of ninety-five separate local government authorities in the London Civil Defence Region has not led to the most effective action in dealing with the social consequences of bombing.

Once the *Blitzkrieg* has failed, the objective of enemy attack, as already indicated, becomes the general dislocation of war effort. The task of civil defence is to take the necessary steps to minimize the harmful effect of attack, and to put into action wider measures required to adapt the civilian population to an environment partly conditioned to the danger of attack.

With regard to direct action, the only possible generalization is that the A.R.P. services have worked well. A suggestion which calls for careful consideration is the provision of a service of welfare wardens whose business would be to reach the scene of an 'incident' as quickly as possible in order to direct people to rest centres, and look after the needs of those who take temporary refuge elsewhere. Such a service is actually in operation in Birmingham and some other provincial cities, and it might be embodied in the existing wardens' organizations. Other provisions to deal with social rather than physical casualties also require strengthening. Rest centres, billeting, re-housing and house-repairs have an important contribution to make to the maintenance or restoration of health and morale.

With regard to shelters, criticism in the last six months has been directed more at the low standard of amenity than at the low standard of protection. If a policy of dispersal had been faithfully followed in practice, there would have been no amenity problem. While in many shelters opportunities for communal activity have been used, and attention is being given to recreation and study—more than four hundred evening classes are being run in shelters by the L.C.C.—the most important aspect of the provision of amenities is that of health.

The seriousness of this question of health is well brought out by one of the most important sections of the broadsheet. It is not merely that many thousands of Londoners spend their nights either in overcrowded, uncomfortable and dirty public shelters, or in cold and damp shelters of the Anderson type. The resistance of Londoners to illness is also being reduced by rising food prices and rationing, by longer hours and less holidays. Moreover, bombing constitutes a direct threat to health through damage to water-mains and sewers, leading to risk of the dissemination of typhoid and paratyphoid fevers. The interruption of services such as water, gas and electricity leads to lower standards of cleanliness and personal hygiene.

The impairment of individual resistance in ways such as these, coupled with the depletion of health services by withdrawal of personnel or commandeering of premises, is likely to lead to unusually widespread dissemination of air-borne infections, especially coughs and colds, influenza and pneumonia, streptococcal infections and cerebrospinal fever. Up to the end of 1940, the condition of London in respect of air-borne infections was generally satisfactory. None the less, abatement of overcrowding by providing more shelter space and air per person, disinfecting the air and mechanical obstruction of the dissemination of respiratory 'droplets' by the use of mouth masks are measures which should be encouraged.

Besides such measures in the shelters, there are broader measures of combating infection. Resistance to infection could be built up by measures of mass immunization as well as by protective foods and adequate rest, and the chances of infection should be minimized by intercepting infectious cases before they reach the public shelters, as well as by detecting infectious cases in the shelters and isolating them as quickly as possible. The importance of communal feeding in maintaining individual resistance under these conditions is obvious. This question involves close co-operation with the Ministry of Food as well as with the Welfare Department of the Ministry of Labour and National Service.

The problem of health, like that of evacuation or of industrial mobilization, cannot be dealt with in isolation. It must be handled against the broader background of the national life. The needs of the inhabitants of large cities under intensive air attack cannot be satisfied by having regard to their private lives alone. We must take into account also their working conditions and the conditions under which they travel to their work. Communal feeding, and even the Ministry of Food's scheme for supplying meals in London shelters, should not be considered entirely without reference to industrial canteens, the use of mobile canteens, and the exigencies of rationing imposed from time to time by the food situation.

Such complexities as these are responsible for the strain which is being placed on administration, whether in regard to the maintenance of such public services as transport, water, gas or electricity supply, and the institution of repairs when needed, or in the extent of the resources and ability which the present local government units have at their disposal. The P E P broadsheet points to one conspicuous gap in the field of utilities, namely, the absence of organization to deal with salvage, particularly commodities, and also stresses the need for some greater sharing of disposable revenues in the London boroughs. More effective linking of regional and local executive officers is also clearly required, and there has already been a marked tendency to rely on regional administration where local administration has proved ineffective.

The broadsheet shows very clearly the impetus to regionalism which the impact of bombing on London has given, and the opportunity for general reorganization which has been provided. Continuous research into such problems might well lead to an effective combination of regionalism with democratic devolution of responsibility. Any breakdown of traditional social arrangements, notably the medical services, and the finance of local government, should lead to their radical overhaul. The decentralization of industry and public administration may have a profound effect on the future economic and social structure of Britain, while the part played by the civil population in defence of their homes and work-places expresses a conception of public service which should find a permanent place in the national life of the country.

SUICIDE OF THE HUMANITIES

To Hell with Culture

Democratic Values are New Values. By Herbert Read. (The Democratic Order, No. 4.) Pp. 64. (London: Kegan Paul and Co., Ltd., 1941.) 1*s*. net.

THIS may not seem an appropriate place to review a book in which the word science is never mentioned, and from which the very conception of scientific activity is totally absent. But, as recent correspondence in NATURE has shown, many men of science feel themselves a part of the cultural tradition of our civilization, and they cannot be expected to remain unmoved at the spectacle of so respected a critic as Mr. Read committing *hara-kiri* in the name of culture as a whole. At least they may look to their spiritual pharmacopœia to see if there is not some remedy which they can prescribe for the patient.

Mr. Read has little difficulty in demonstrating that 'culture', in the conventional sense of painting easel pictures and writing poems, is in a bad way, and has degenerated into a mere decorative veneer plastered over the realities of our daily lives. Men of science, however, will be tempted to point out that our civilization is now dependent on scientific techniques at every point, equally in the most fundamental matters such as food-raising and in the most superficial titbits such as the colours of ladies' lips, and that a culture which forgets its scientific components is obviously foredoomed to evaporate into hot air. It is perhaps because Mr. Read does uncompromisingly omit any reference to scientific thought that his suicide is so clearly 'while of unsound mind'.

He begins by defining democracy as being the realization of the three fundamental tenets of communist economics: production for use, from each according to his ability, to each according to his needs, and the ownership of industry by the workers. This may be rather like defining a rose as a heavy soil and plenty of farmyard manure; but let that pass. He proceeds to his most valuable and profound point, that a living democratic culture is an attitude of mind which permeates and fertilizes every activity of every individual; it is not a thing apart, to be tasted only on Sunday afternoon excursions to the museums, but is a flame perpetually burning in the mind. A valid culture, he says, must be there in the fingertips of a potter as he throws an ordinary beer-mug on the wheel; it is an example to catch the imagination of the Neolithic craftsman rather than of our present industrial proletariat, but the point it is making is one which must be the very basis of a modern democratic civilization.

There is here, surely, a promising line of attack on one of the problems facing men of science to-day, namely, how far they should take up definitely political or administrative work. From a long-term point of view at least, the mode of operation of a cultural activity such as science should be through its influence on the general outlook and presuppositions of the ordinary man. The social function of a good man of science is not to become a bad administrator, but to encourage and direct the scientific interests of his fellow citizens, from politicians to washerwomen.

When Mr. Read attempts to show concretely what the inspiration of culture would mean in daily life, he produces only an out-and-out functionalist theory of æsthetic value. But is this ever-present culture really no more than an attention to function? A bronze Han amphora holds no more wine, and holds it no better, than the crudest Brummagem jug. Without claiming to have any special qualifications of æsthetic training, one may wonder whether the motor-cars which Mr. Read finds so satisfactory have any more claim to beauty than a fashionable 'Vogueish' elegance. Efficiency is an ingredient in beauty, perhaps even a prerequisite for its creation. The invention of the internal combustion engine made it impossible to go on designing the most beautiful vehicles yet made by man, the Victorian hay waggons and carriages, just as the steam engine put the clipper ship into the category of an out of date *genre*. A living culture must value efficiency, which to-day means valuing science; but it is not enough to pay attention only to its sleight-of-hand trickery in getting material results.

The fundamental contribution of science to culture, and one whose neglect is most damaging to Mr. Read's argument, is the concept of workable compromise. Every scientific theory is a compromise, between those things which it fits and accounts for, and those which it does not. The attitude of the man of science to it is a compromise, a mere suspension of disbelief. His most powerful logical weapon, as Hardy has recently pointed out, is the beautiful and subtle method of *reductio ad absurdum,* in which an uncompromising logical argument is allowed to destroy itself. It is a technique of thought which cannot be avoided in any system with an empirical reference; nothing is more absurd than a perfectly logical theory which does not produce the right answers, and nothing more useless. Other cultural activities, such as painting and writing, do not suddenly find Mother Nature pouring on their heads a jug of real, and very cold, water. They can carry theories to their logical conclusions, and there is no one to laugh. In the last twenty years they have done so in almost every field. The study of formal design had already by 1918 been carried to the point where Rodchenko and Malevitch were painting white shapes on a white background; the study of pictorial association led Masson and some of the Surrealists to paint by automatic writing; and Hugo Ball and the poets of "Transition" wrote in purely nonsense syllables.

Men of science, who after all spend most of their time being incomprehensible to their fellow citizens, cannot object to incomprehensibility in the arts. But in a scientific theory the 'difficult' theoretical statement is merely an intellectual compromise with a stubborn body of facts, and is given up if it is reduced to absurdity by failure to give a tolerably complete account of them. Culture in recent times seems to have copied the boldness of science in introducing queer notions, but not the tentativeness with which science advances them. Mr. Read, in fact, adopts the fashionable view that a *reductio ad absurdum* is a good thing in itself, not a ground for rejecting a theory but a proof that the analysis has been made on the right lines and has revealed the "contradiction of opposites" which is supposed to lie at the heart of every phenomenon. This theory, which is often passed off as Marxist thinking (perhaps rightly, but that is a matter for the exegetes), is itself the exaggeration to the ultimate extreme of the valuable scientific technique of analysis in terms of competing processes. Since it postulates a conflict which cannot be reconciled within a single framework of causality, but inevitably requires a transition to a "higher synthesis", it leaves one with no guide as to what the outcome of a given situation will be, and one can name the winner with a free conscience. Mr. Read, for example, points out the conflict between utility and decoration in the design of a beautiful object, shows how the two considerations are irreconcilable in our present capitalist world, and then designates utility as the sole arbiter of taste in the future.

Again, and more importantly, he shows how the creative spirit of man is brought to naught by the restrictions of a competitive and monopolistic society; and he demonstrates how this gives rise to a rigid distinction between the artist and the workman. His solution is again a runaway win, this time for the workman. He envisages a society in which there are no specialized artists, but in which every individual realizes his full originality as an integral part of an all-embracing community; as an example he mentions the medieval guilds who built the great cathedrals, though one would have been interested to have his account of how their overwhelmingly religious preoccupations fit into his theory of the functional basis of beauty. Such a suggestion could scarcely have been the product of the compromising scientific method of thought; and it could scarcely be applied to the scientific aspects of cultural activity. Every man his own Einstein is a *reductio ad absurdum* of a slogan, if ever anything was.

The antagonism between freedom to create something new, and integration into an ordered society, shows every sign of being a permanent conflict. It can certainly not be resolved by nominating one side or the other as paramount. Men of science may perhaps be pardoned if they suggest that it is, at the present time, more satistorily dealt with in the scientific field than in any other. Science is an ordered whole, not an anarchy like literature or painting; but even its most cherished tenets can, with considerable but not undue difficulty, be upset by anyone who shows himself capable of doing so. To transfer this solution to other and more general fields of activity would be difficult, but there is no reason, in an economics of plenty, why it should be impossible. What is necessary is to ensure that a man can make enough to live on while doing something which most people believe to be mistaken, but not ridiculous; mistaken because it is new, not ridiculous because it is part of an ordered whole. A cultural activity which has solved this problem as well as science has done still has something to offer to the basic notions of civilization, and is justified in asking Mr. Read to "include me out" of his "To Hell with Culture."

C. H. WADDINGTON.

APPLICATION OF ATOMIC THEORY TO SOLIDS

The Modern Theory of Solids
By Prof. Frederick Seitz. (International Series in Physics.) Pp. xv+698. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 49*s*.

THE theory of solids is a title which might include many branches of science which are not treated in this book; for example, elasticity, plasticity and the mechanics of rigid bodies. Its subject-matter is more restricted, and can be described as the application of the discoveries of atomic physics to explain the properties of solids. Successful applications have been achieved in three main fields: magnetism, the electron theory of metals and the electrostatic theory of ionic crystals. Especially since the introduction of quantum mechanics, each of these subjects has had an important influence on the others, and this book is the first, so far as I know, to treat them all in the same volume.

In the history of modern physics, it cannot be claimed that the study of solids has led to the discovery of important new laws such as those which have been found through the investigation of gases, atomic spectra and fast particles. The properties of solids have lent important support, however, to principles discovered in other ways. For example, Einstein's discussion of specific heats was one of the earliest applications of the quantum theory to follow Planck's treatment of black body radiation, and Lorentz's derivation of the relation between electrical and thermal conductivity of metals showed the electron to be a constituent of solid conductors. More recently, Sommerfeld's discussion of the specific heats of metals and Bloch's of the conductivity at low temperatures provided substantial additions to the mass of evidence which was marshalled in support of the new quantum theory within a few years of its formulation.

It is also true that most of the research workers who are working on solids at the present time are not doing so with any hope of discovering new laws of a fundamental kind. Nobody doubts that quantum mechanics is an entirely adequate theory to cover nearly the whole field, and that, though in the future our interpretation of the symbols may possibly change, the equations of quantum mechanics are as valid to describe the processes of physics and chemistry as those of Newton to describe the behaviour of the planets. Where the quantum mechanics of to-day breaks down is, as we know, within the nucleus, and in dealing with very fast particles or with the properties of the newest particles such as neutrons and mesons. To describe the properties of atoms as they exist in solids, it should be just as successful as Newtonian mechanics is in astronomy without the refinements of relativity. There is, however, one phenomenon, of major importance, namely superconductivity which has hitherto resisted all attempts at an explanation, and it is just possible that this is due to a defect of present-day theory rather than to lack of skill on the part of the theorists. It may be that at very low temperatures some small unknown term in the interaction between electrons influences their properties in this unexpected way. But the balance of probability seems to be against this; certainly no one has been able to deduce from this phenomenon that quantum mechanics is untrue.

The study of solids can therefore only be pursued with two worthy ends in view; it can be pursued for its own sake, as an æsthetically satisfying body of knowledge, like the pure mathematics of Prof. Hardy's "Apology", or it can be undertaken because it may help the practical men who use solids. Its claims under the first head are not entirely negligible, though nothing can, of course, be claimed comparable with the exquisite rightness of Dirac's theory of the electron or with Einstein's relativity. But some elegant and beautiful work has none the less been done, especially since the introduction of quantum mechanics. I may mention in particular the theory of the motion of an electron in a periodic field, with its satisfying explanation of why some solids (for example, metals) conduct while others do not, and its rather surprising power to account for some of the queerer regularities of metallurgy, such as the Hume-Rothery rule.

As a guide and stimulus to the practical physicists and metallurgists no one will deny that the theory of solids is of value. With this end in view, it seems to me more worth while to attempt to correlate observed phenomena and to give a general explanation in terms of atomic physics, than to attempt any sort of quantitative explanation of phenomena so complicated as those that occur in solids. In the theory of metals, for example, a very simple explanation has been given by Wigner and Seitz of how metal atoms cohere, and a rough quantitative application to sodium made. Further, in a qualitative way the difference between sodium and, for example, copper or nickel can be understood. But I question the value of attempts to improve these theories quantitatively; these attempts are usually not very elegant or pleasing, and are too complicated to be helpful or suggestive to the experimental worker. In fact it seems to me that in this field a fact is only worth explaining if it can be explained simply; for example, if a phase diagram in metallurgy can be explained by Hume-Rothery's rule or some similar generalization, the explanation is worth while, but if it depends on some long calculation which balances up the energy of one phase against another, it had better remain unexplained.

My only criticism of Dr. Seitz's book is that this does not seem to be recognized; it is difficult to separate the important and suggestive theories from the superstructure that has been built on them in the attempt to get quantitative agreement with experiment. The book is very complete; the student will have no difficulty in finding out what has been done on any subject. The most detailed parts deal with Born's theory of ionic crystals, and with the basis of the modern electron theory of metals, namely, the theory of the motion of an electron in a field having the symmetry of various crystals. There are chapters or sections dealing with various special applications such as luminescence, *F*-centres, ionic conduction, phase transitions and so on. Dr. Seitz is to be congratulated on writing a book which, through its completeness and reliability, will be of very great value.

N. F. MOTT.

SCHOOL PHYSICS

(1) General Physics

By W. L. Whiteley. Pp. viii+590. (London: University Tutorial Press, Ltd., 1940.) 7*s.* 6*d.*

(2) Intermediate Practical Physics

By T. M. Yarwood. Pp. xii+308. (London: Macmillan and Co., Ltd., 1940.) 6*s.*

(1) THE aim of this book is to provide a course in general physics to the School Certificate stage which will enable pupils to build up, on an experimental basis, a knowledge of physical principles and an appreciation of their importance in daily life; and both author and publisher are to be congratulated upon the success with which this aim has been achieved.

The writer has eschewed padding in any form, but has not sacrificed interest or become dreary in the process. The writing is clear and lucid throughout, and the diagrams are ample and good; applications and illustrations are dealt with, and it is quite remarkable how much has been included in his survey.

The book is very good value; were it not for the narrow margins, and the date, one would certainly not imagine it to be a war-time production; it is a thoroughly satisfactory and competent piece of work.

(2) Mr. Yarwood has furnished sufficient material to provide either a one-year or a two-year course in practical physics, the chief aim being to deal with experiments that will help the student in his theoretical work after he has passed the School Certificate stage. In this the author may certainly be deemed successful. He says, very well, that though the student in pursuing such a course as this does not do any pioneer work, none the less the spirit of investigation should underlie the practical exercises; he assumes, very sensibly, that the student will already have had some experience of practical work; and, in a short introductory section he gives a number of useful notes on method, errors of observation, accuracy of measurements, calculation of results, and graphical work.

The experiments dealt with include nine in properties of matter, nineteen in heat, twenty-seven in light, five in sound, thirteen in magnetism, and thirty-three in electricity, and among them has been found room for the fourth power law of radiation, defects of lenses, Newton's rings, Lloyd's mirror, the frequency of the A.C. supply, and the thermal emissivity of a wire: such items add greatly to the inspirational value of the book.

The reviewer questions the soundness of the explanation of Hope's experiment, given on p. 46. Though a belt of ice will form on the inside of the can, round the middle, it is extremely doubtful if any crystals of ice actually become detached so as to be able to rise. It is more probable that cooling of the upper part is brought about by progressively advancing convection currents. There are also two or three slips which might well be rectified as soon as opportunity arises. On p. 63, for example, the first note is incorrect, as has actually been made clear eight lines above; the diagram on p. 115 is carelessly drawn, and Note 1 on p. 122 is incorrect: the critical angle for glass to air is not the one actually measured, but the angle between the normal and incident ray at the liquid-glass interface which gives rise to total reflexion at the glass-air surface: this angle, as is proved, is equal to the critical angle for light passing directly from liquid to air. These points are not of major importance, and certainly do not detract appreciably from the general merit of the book.

B. M. N.

Outlines of Structural Geology

By Dr. E. Sherbon Hills. Pp. ix+172+4 plates. (London: Methuen and Co., Ltd., 1940.) 6*s.* 6*d.*

THE author of this admirable little book tells us that his aim has been to present "a brief, yet reasonably complete and well-documented summary of structural geology, with special reference to those aspects of the subject with which the field geologist should be acquainted". Dr. Hills has been highly successful in attaining his object. The chapters deal in turn with non-diastrophic structures (for example, primary structures of sediments, effects of moving ice and subaqueous slumping); mechanical principles of rock deformation; major crustal structures; folds (geometry and description, mechanics of formation, and associated structures such as joints and cleavage); faults (nomenclature, description, and associated structures, such as slickensides and tension fractures); structures of igneous rocks (flow, fracture and tectonic relationships); and finally, petrofabric analysis.

The last two chapters, giving for the first time in an English text-book a concise and reliable account of the results of recent work in two difficult but profitable fields of research, will be particularly welcomed. Topics such as isostasy and the fundamental causes of diastrophism have been omitted, quite properly, in a book of this scope. There are, nevertheless, instructive discussions of geosynclines, nappes and other alpine structures, and rift valleys. In connexion with the last of these, one is glad to see full reference to Wayland's compression hypothesis and the support given it by Bullard's gravity measurements across the African rifts. Indeed, the book is commendably up to date throughout, and ample guidance to wider reading is provided by numerous and well-chosen references to the leading literature.

The book is copiously illustrated with very clear and well-drawn diagrams and figures, and these, together with an effective series of excellently reproduced photographs, add greatly to its educational value. Both as an introduction to the subject and as a sound and balanced review of its present status the book can be strongly recommended to students, teachers and geologists in general, by all of whom it should be highly appreciated.

Advanced Readings in Chemical and Technical German

From Practical Reference Books; with a Summary of Reading Difficulties, a Frequency Vocabulary List and Notes. Selected and edited by Prof. John Theodore Fotos and Prof. R. Norris Shreve. Pp. xliii+304. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940.) 15*s.* net.

THE selections for translation given in this book have been chosen from seven standard works of reference in German, which cover inorganic and organic chemistry and metallurgy. No explanation is given as to why physical chemistry has been excluded, and the omission seems curious. There is an introduction giving some points of German grammar and construction which would be useful in revision. A minimum chemical German vocabulary arranged in numbered order of frequency of occurrence follows. Since physical chemistry is not represented in the book, this order is purely accidental and of no real value.

The extracts for reading follow, each with a vocabulary and notes explaining points of interest or difficulty. These extracts are full of arithmetical numbers, but no table of German equivalents of these is given, so that anyone reading "19,25°" would be likely to think of the English rather than the German words for this.

There is no doubt that this book should prove useful, although the highly condensed style of the works of reference used as sources does not provide a representative specimen of the journal literature, which is probably consulted to an even larger degree.

New Style Exercises in Biology

Part 1: Botany. By F. Whitwam Jones. Pp. 64. (London: J. M. Dent and Sons, Ltd., 1940.) 1*s.* 4*d.*

IF only for its novelty, Mr. Whitwam Jones's book is worthy of earnest consideration. It consists of a series of detachable pages containing a variety of exercises and questions which, according to the author, should help the pupil of School Certificate standard to confirm, apply and extend the knowledge which he has gained during his school training. As an interesting attempt to help pupils to attach thoughts to words, the book must be well praised. Yet one of the great dangers of instruction of this kind would appear to lie in the development of a rigid uniformity in the type of apparatus used in each school in order to make the student familiar with the "classic" experiments in vogue at the time. This would inevitably lead to a sidetracking of initiative in teaching method and to considerable restriction in improvization in the devising of experimental material, factors which are of the greatest importance in the progress of good science teaching.

The idea behind the book is laudable, but is one that would appear to bear the richest fruit only if applied by the individual teacher each year for the pupils in his or her school. A far more serious criticism is that Mr. Jones's teaching seems to be confined to biological issues in which the extreme worth of his subject in social and human relationships is completely omitted. Perhaps this omission is rectified in the second part of this book, which is yet to be published.

T. H. H.

French-English Science Dictionary

For Students in Agricultural, Biological, and Physical Sciences. By Prof. Louis DeVries, with the collaboration of Members of the Graduate Faculty. Pp. viii+546. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 24*s.* 6*d.*

THIS dictionary of 43,000 entries includes terms of agricultural, physical, chemical, geological, medical and biological interest as well as many literary terms. About five hundred idioms are also given. A list of French abbreviations and their translation into English is appended. The book should be useful to all students of science.

RESEARCH IN CANADA

By Lieut.-General A. G. L. McNaughton, C.B., C.M.G., D.S.O.

Formerly President, National Research Council of Canada; General Officer Commanding 1st Canadian Corps Overseas Forces

The National Research Council

THE organization of research in Canada as a function of government dates back to 1916, when an honorary Advisory Council for Scientific and Industrial Research was set up. It was not contemplated at that time that this Council would establish laboratories of its own; it was to act as an agency for consultation and co-ordination between those already carrying on research in the existing laboratories of the several departments of the Dominion and Provincial Governments, in the universities, and in industry.

A report prepared at the time indicates that the total annual expenditure on research in all governmental laboratories, both Dominion and Provincial, amounted to considerably less than 100,000 dollars; and that of some 2,400 leading Canadian firms engaged in manufacturing who replied to the questionnaire, only 37 had laboratories which even pretended to engage in research.

As a result of the pressure of public opinion concerning these limited facilities, the matter was repeatedly considered in Parliament, and, eventually the Research Council Act was passed in 1924.

The Council's main laboratories, situated at the junction of the Ottawa and Rideau Rivers, were commenced in 1930 and opened at the time of the Imperial Economic Conference in 1932.

By 1939 the Council's annual budget on current account was somewhat more than a million dollars. Meanwhile an even more striking increase had taken place in the facilities in Canadian industry itself, and by 1938 it is estimated that these comprised upwards of 1,000 industrial laboratories for research, testing and plant control, with some 2,500 professional workers employed full time. Similarly in the Dominion Departments of Agriculture, of Public Works, of Mines and Resources the last two decades have seen the creation of a number of research and testing laboratories related to their special functions and duties, all of which represent a very substantial asset. Elsewhere the most notable addition was the Ontario Research Foundation, which operates in the most friendly relations with the National Research Council.

In 1938 provision for a further large group of laboratories to provide the Council with additional facilities, particularly for aeronautical engineering, hydraulics and high-voltage electrical engineering, was sanctioned by the Government. Construction was started in 1939, and is now advanced to the point that in some cases the buildings are in occupation.

As a result of these measures, at the outbreak of the present War, Canada had the laboratories and trained staffs competent to act as a nucleus in undertaking the study of the problems presented in almost every field of war requirements both within the sea, land and air forces themselves and also in the industrial life of the country as it had to be re-oriented to produce the vast and complicated supplies needed in transition from a peace to a war basis.

But the adequacy of physical equipment and technical staff is only one side of the question, and what is probably equally important as an asset is the organization of the Council itself as a going concern, and the intimate relations which had been developed with every branch of science in Canada—with universities, with industry, with departments of the Dominion and Provincial Governments concerned with research problems, with the great professional societies in medicine, engineering, forestry, etc., with the Canadian Engineering Standards Association in the field of industrial standardization, and many others.

The National Research Council consists of fifteen members selected for terms of three years from among men prominent in scientific work in Canadian universities or in Canadian industry. The Council is required by statute to meet at least four times annually in Ottawa. There is a president, appointed by the Governor in Council for a term of years, who reports directly to the Privy Council Committee on Scientific and Industrial Research of which the Minister of Trade and Commerce is the chairman. The office of president is now filled by Dean C. J. Mackenzie, professor of civil engineering in the University of Saskatchewan.

Apart from administration, which is organized much on the usual lines of a department of Government, the staff of the Council is grouped in a number of divisions each under a director.

The Divisions of Physics and Electrical Engineering, Chemistry, Mechanical Engineering including Hydraulics and Aeronautics, Biology and Agriculture are responsible for the direction and

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* Substance of a paper read before the Royal Society of Arts on May 13.

conduct of the technical work in the fields indicated by their designations. There is a Section on Research Plans and Publications concerned with the collection, collation and issue of scientific information and with the general development of co-operative investigations through committees, etc. There is also a Section on Codes and Specifications, matters which are in the highest degree important in relation to mass production in war. Provision is made for the closest co-operation and collaboration between all branches concerned in any particular problem.

One of the great advantages possessed by an organization such as the Council's own laboratories with their comprehensive representation of all branches of science is that experts in every line required can be brought together at short notice to study a problem and to work as a team for its solution. This facility is very important, for in most research problems related to industrial or agricultural production or processing we are usually confronted with limiting factors of many kinds, and it is not easy in advance to determine in which branch of science the answer should be sought. For example, in a recent study of the cold storage of chicken which had developed a defect called 'freezer burn', which spoiled the appearance and marketability of the birds, the work started in the hands of biologists and mycologists on the supposition that a fungus was involved ; then chemists were required to study the breakdown products, and in the end the answer was found to lie in the very precise control of humidity at low temperatures—a solution contributed by the physicists and engineers.

ASSOCIATE COMMITTEES AND CO-OPERATIVE RESEARCH

In order to bring to bear the knowledge of scientific men in other institutions and in industry and to correlate the work of research in all organizations concerned, a number of so-called Associate Committees have been set up. The function of these Committees is to direct co-operative research on the problems assigned to them ; to settle the objectives ; to indicate the individuals or organizations which should undertake the several component parts of the inquiry ; to receive and co-ordinate the resulting information ; and to make it available to those who will turn it to advantage.

The Council endeavours to ensure that these Committees are comprehensively representative of all interests and we expect them, each in their proper sphere, to form a national plan into which all who are in a position to contribute information can fit their own particular lines of research. The actual investigations are carried out, not only in the Council's laboratories, but also in the laboratories of the various universities, Government departments and industrial institutions throughout the country ; also much of the initiative in these Committees lies with the outstanding experts from other organizations who have associated themselves with the Council in this work.

Time does not permit me to recite to you the long list of these associate committees or to go into, in any detail, the important tasks which they are carrying out for Canada. But, in order to carry some picture of the wide range of work involved, I would, however, by way of illustration, like to mention one or two in several diverse fields.

In agriculture I would mention the Committees in charge of Grain Research and of Transport and Storage of Food ; these, both by reason of the great importance of the subjects and also on account of the very substantial results which have been achieved in comparison with the trifling expenditures of money which have been made.

The Grain Research Committee is a co-operative organization with the Department of Agriculture, on which the western grain growers, provincial agriculture departments, plant breeders, etc., are represented. It has developed new varieties of rust-resisting wheat, and these have been thoroughly tested, not only from the rust-resisting point of view, but also for their milling and baking qualities. We have every confidence in them and they have now been multiplied and the seed made available in considerable quantities for use in the areas where rust is most likely. Canada has suffered losses due to rust alone of 100,000,000 dollars in a single season. If we can take that element of hazard out of the grain-growing business it tends to put it on a better basis and gives some increased assurance to the farmer as to what he will reap when he has sown.

With Canada's mounting surpluses in wheat which she could not market in consequence of the changing policies of European countries towards self-sufficiency in growing their own grain, she has had to turn the attention of her farming committees more and more to livestock and poultry, and the work of the Committee on Transport and Storage of Food, another joint undertaking with the Department of Agriculture, has extended all the way from detailed investigations of the Canadian ports to determine plans for the cold-storage facilities needed for this trade to the conduct of a bacon survey in the United Kingdom.

In forestry, I would mention the Committee organized in co-operation with the Forest Service of the Department of Mines and Resources. This Committee has concerned itself with such matters as the study and mitigation of forest hazards, through fire, insects and other pests; with the preparation of a manual giving advice as to the management of the 'farmer's woodlot', a most important source of raw material. This manual is now in general use in the Maritime Provinces and Quebec.

Perhaps the most interesting project is concerned with tree breeding, which a few years ago would have been deemed a fantastic enterprise because of the hundreds of years which would have been required to bring into existence a new tree species and fix its characteristics; but now we have colchicine, a drug which, administered to a plant shortly after pollination, causes a very great increase in the varieties or sports to occur in the next generation, thus giving wide scope to the plant breeder for selection. Nothing occurs which would not otherwise occur naturally, but you may get, if you are fortunate, in a single small plot, in a single season, a multiplicity of varieties which otherwise would take years of patient work to collect.

Another interesting line of research which is being developed by this Committee is the vegetative reproduction of desirable species through the use of plant hormones, a number of which were first synthesized and introduced to science from the chemical laboratories of the National Research Council.

These very remarkable substances in minute, almost microscopic, doses have the property of stimulating root formation. By treatment with these hormones, cuttings of plants, which otherwise would normally not root, can often be induced to do so. One important use of this technique is in the reafforestation of areas where the trees have been destroyed by some pest like the white pine blister rust. Even in the worst areas some trees survive due to some natural inherent resistance. Cuttings from these trees are taken, treated with hormones, rooted and grown in the nurseries as planting stock. These young trees have all the natural heritable characteristics of the original tree from which they came and thus are immune to the disease in question.

I could continue with examples of the work of many other associate committees in the fields of medicine, chemistry, physics and engineering; of the detailed and exacting work carried out by joint committees with the Department of Finance in the preparation of a National Building Code for Canada which is now, despite the War, in process of publication and which should bring order into a situation which, under the conflicting jurisdictions of municipality, province and dominion had become most seriously confused to the disadvantage of the public.

I would just like to record my tribute to the co-operating institutions and to the hundreds of men and women with special scientific or industrial training and experience who, without any remuneration whatever, have associated themselves with the Council in this work and out of whose collaboration many important and useful developments have been and are being brought to a successful conclusion.

ASSISTED RESEARCHES

In order to make use of the facilities for research which exist in a number of Canadian universities and to encourage their further development, the Council in the early years of its existence instituted a system of assisted researches through which the professors in charge could be given financial assistance for the provision of needed apparatus, laboratory help and similar out-of-pocket expenses other than their own salaries.

Applications for these are most sympathetically considered; much useful work has been accomplished of value both for the new knowledge secured and, perhaps even more important, for the training given to the workers.

SCHOLARSHIPS

Another aspect of the Council's concern with the training of research workers is represented by the scholarships which each year are awarded to some seventy or more post-graduate students. These are tenable at Canadian universities or, in special cases, abroad. Through these scholarships which are being given year by year in increasing numbers, in addition to providing the needed supply of highly trained research workers, a deliberate attempt has been made to assist the building up of the post-graduate schools in the Canadian universities.

ENCOURAGEMENT OF RESEARCH IN UNIVERSITIES, ETC.

While the National Research Council has itself a number of very well-equipped laboratories in all lines, yet there has been no attempt to monopolize research; in fact, the very opposite, for it has long been realized that for the safety of the nation against peace-time industrial competition, let alone to meet the needs in war, you can never have too much research.

In Canada the difficulties are particularly acute for, as is well known, most of her principal industrial companies have affiliations with larger organizations abroad to whom there has been a natural tendency to refer any research problems that arise from time to time. It is often very difficult to examine these problems completely apart from the special environment in which they have come to attention and the solutions proposed are often, therefore, inadequate, and, both on this ground and on account of delays, very heavy losses are involved.

A more serious loss is due to the fact that without a corps of trained investigators on the spot, the needs of the situation are not fully appreciated and many opportunities for useful inventions and developments are missed or unduly delayed.

RESEARCH INFORMATION AND INTERNATIONAL AFFILIATIONS

In peace-time, in order to maintain contact with research work going on all over the world, the National Research Council maintains membership in the principal international scientific conferences and meetings, arranges for Canadian representation where required and collects in its library in Ottawa for reference, copies of all papers, proceedings and other information of importance. This is made available as desired to Canadian workers.

For many years also the Council has maintained the closest possible contacts with the Department of Scientific and Industrial Research and the British Standards Institution in Great Britain. These contacts were much strengthened and developed by the Imperial Conference of 1930 and the Imperial Scientific Conference of 1936 and again in August 1939, on the occasion of the visit to Great Britain of a representative group of Canadian manufacturers who had come to Great Britain to familiarize themselves with the needs of war-time industry so that Canadian production could be directed to those articles which would be most required and most useful.

WAR-TIME DEVELOPMENTS

So far as war-time developments are concerned, I am under the difficulty that no specific information which would be of value to the enemy can be disclosed, so I have to content myself with a few illustrative statements which must be rather general in character.

First, as regards finance, the funds placed at the disposal of the Council for the current year by votes from Parliament and grants-in-aid from the Naval, Land and Air Forces in the Department of National Defence are some fivefold greater than for the last pre-war year. In addition the Council and its technical staff will be responsible for the scientific and technical organization and advice in connexion with other projects not directly administered, which will involve about twice to three times as much again.

Further, in order to provide some measure of elasticity in the finances of the Council, a number of Canadian corporations, large and small, and private individuals have joined together to establish a trust fund of much more than a million dollars, with more available if required. The committee in charge has been enjoined by the donors to make it its business to ensure that no worthwhile project of research, related to the war effort of Canada, which is sponsored by the National Research Council, should be delayed or hampered by lack of money. In this public-spirited group the mining industries of Canada have, as usual, been conspicuous for their generous support of research. Another example of the assistance received from this source is the support given to the Canadian Corps in the organization and equipment of their tunnelling companies. One of these, as is well known, is now at Gibraltar making effective use of the modern machinery presented by the Canadian mining industry. The other Company is using similar equipment in Great Britain.

What is, in effect, a further additional expansion of the Council's activities is represented by Research Enterprises, Ltd., a wholly owned Government corporation which has been set up by the Canadian Ministry of Supply primarily to produce for the armed forces and for industry, inventions and apparatus which had been developed in the Council's laboratories. Already, optical instruments, including gun sights and range finders, radio gear and similar articles, are in production in the large new factory which has been erected, and very shortly the company will be turning out its own supplies of optical glass in quantity.

Thus a small nucleus established in the optical and radio laboratories in the years before the War has been given substance and developed into a key industry of essential importance for our war effort.

The Council's Metrology Laboratories are another example of a small but effective nucleus which has been expanded to large dimensions to care for the standardization of the vast numbers of gauges necessary in the munitions industry.

In the field of radiology, special attention has been paid in the Council's laboratories for many years to the examination of castings, particularly those in light alloys required to carry stress in aircraft construction. Working with the producers the technique of making sound castings had been developed before the War to a high degree of perfection, and the knowledge of this art is now proving of great value to the Canadian aircraft industry.

X-ray photographs up to 600 kv., which is sufficient to penetrate several inches of steel, can be taken. For greater thicknesses a plentiful supply of radium is available by reason of the fact that the bulk of the world's new supply derived from the mines at Great Bear Lake and refined by the Eldorado Company at its Port Hope plant comes to the Council for test and certification.

Turning to another of many fields, I would like to mention the very important programme which has been initiated by the Committee on Aviation Medicine under the chairmanship of the late Sir Frederick Banting. It was on the business of this Committee that Sir Frederick was proceeding to England when he lost his life in a flying accident (see NATURE of May 3, p. 535).

All this great range of work of which I have been speaking is going forward in Canada in the closest sympathy and understanding both with the authorities in Great Britain and also with our mutual friends and colleagues in the United States. In order to help in the maintenance of effective contact the British Government has established a Scientific Liaison Office with the Council in Ottawa and we have been privileged to receive first Prof. R. H. Fowler and more recently Sir Lawrence Bragg.

At the present time a number of the senior members of the National Research Council are in England to familiarize themselves with the latest methods and requirements so that work in Canada may be kept related to problems of immediate practical importance.

There is a constant flow and interchange of workers and the various problems are taken up as available facilities best indicate. Needless to say, there is no delay or reservation in making the results available for application and use.

TERCENTENARY OF NEHEMIAH GREW (1641–1712)

BY DR. AGNES ARBER

NEHEMIAH GREW will always be held in honour by botanists as the co-founder with Marcello Malpighi of the science of plant anatomy. It is true that in his ideas about plant cells he did not advance much beyond Robert Hooke, who, in 1665, figured and named these units; but, as regards knowledge of vascular structure, the position is very different. Grew and Malpighi not only initiated the study of the bundle system of the flowering plant, but also carried it to a surprisingly high level, considering that they had to start from the very foundations. Grew's first book, "The Anatomy of Vegetables Begun" (1672), contains the earliest printed illustration showing vascular bundles as seen in section under the microscope. He followed up this work in 1673 and 1675 by treatises on the detailed anatomy of roots and of stems. Finally he brought all his results together, in 1682, in a splendidly illustrated folio, "The Anatomy of Plants", which included improved second editions of his first three books, as well as much additional matter. The excellence of Grew's botanical morphology and anatomy has been recognized fully; indeed his reputation in this line is deservedly so great that it has tended to overshadow the other facets of his output. It seems worth while, therefore, in this, his tercentenary year, to direct attention to certain less specialized aspects of his scientific work.

Grew's general attitude towards biology cannot be understood unless one realizes how deeply he was committed to a mechanistic view of the universe. It seems likely that Hooke, and also Descartes, had to some extent turned his mind in this direction, though in the seventeenth century such ideas were so much in the air that it is scarcely necessary to look for specific sources. It was owing to the mechanistic viewpoint of that period, that the microscope, for example, was hailed as an instrument which was destined to clear away all inconvenient mysteries. Hooke hoped that by the help of glasses "we may perhaps be inabled to discern all the secret workings of Nature, almost in the same manner as we do those that are the productions of Art, and are manag'd by Wheels and Engines, and Springs, that were devised by humane *Wit*". Grew enlarges upon this analogy between the world and a man-made machine, and seems to find it entirely satisfying. He says that "all *Nature* is as one Great *Engine* made by and held in" the hand of God. He regards this engine as having been set in motion by the Great First Cause, to which all subsequent effects can be traced back; he considers that the original causation was all that was necessary, and that, in the normal course of events, no subsequent interference has occurred. "And as it is the watchmaker's *Art*," he says, "that the *Hand* moves regularly from hour to hour, although he put not his finger still to it: so it is the demonstration of *Divine Wisdom*, that the Parts of *Nature* are so harmoniously contrived and set together as to conspire to all kind of natural motions and effects without the extraordinary-immediate influence of the *Author* of it."

This particular philosophy led Nehemiah Grew to regard it as a pious duty to discover a mechanistic "cause" for each phenomenon; he defines "an *intelligible* account" as "such as is grounded upon the *Notions* of *Sense*, and made out *Mechanically*". This mental bias gave him an over-simplified conception of causation, and a "cause" became to him almost something tangible and visually imageable. He thought that "one property agreeing to divers Vegetables should have one cause : for although the scope and end may vary, yet the cause, as it is the cause of that property, must be one". His reasoning thus induced him to underestimate the fog of obscurity which always pervades the realm of causes, and which was even more impenetrable in those days, when biochemistry and biophysics were non-existent.

Grew was perennially sanguine, and he was apt to believe that he had succeeded in solving problems of causation before which the boldest spirits might quail even to-day. As an example we may take his answer to the question of *why* certain elements of plant tissues are elongated and cylindrical. "*Succiferous Vessels*," he says, "from their *Sal Alkali* grow in length ; for by that dimension chiefly this *Salt* always *shoots*. . . . And as by the *saline Principles* the *Vessels* are *long*, so by the *oleous* . . . they are *Cylindrical*" ; if it were not for the "oleous Principle" they would be flat or angular, "as all *saline* Shoots of themselves are, as those of *Alum*". The striking feature of this explanation is not that it happens to be in itself a failure, but that Grew at that early date should have made such a valiant effort after a causal-mechanical interpretation of form.

Grew's mechanistic theory of the universe had the very great advantage that it opened his mind to the mathematical aspects of biology. In 1620 Francis Bacon had lamented that "Nothing in Natural History is found to be . . . numbered up, nothing Weighed, nothing measured", and Nehemiah Grew, in his catalogue of the Royal Society's museum, published more than sixty years later, reiterates the same complaint ; for after noting that in his descriptions he had included the "just Measures", he adds, "Much neglected by Writers of Natural History".

Grew certainly took great trouble to give the exact dimensions of the specimens he studied, and many of the plates in this book are accompanied by a line divided into inches to show the degree of reduction of the drawings. Elsewhere he made the suggestion that the figures in herbals ought all to be "drawn by one *Scale* ; or at most, by Two ; one for *Trees* and *Shrubs* ; and another for *Herbs*". He realized that, for general descriptive purposes, words of more exact connotation than the "great" and "small", of the usage then current, were needed ; he proposed that leaves 5 in. or more in length should be called "great" ; 1–5 in., "mean" ; and 1 in. or less, "small".

When objects of very small size were in question, the biologists of the seventeenth century were faced with the difficulty of not having any adequate standards of measurement. For lack of these we find Grew using such terms of comparison as "about $\frac{1}{5}$th part as big as a *Cheese-Mite*", or "the breadth of a *Marsh-mallow-Seed* or little Spangle". From a twentieth-century point of view, units of this kind may seem wholly unscientific, but when people are forced to use them, in the absence of a more advanced technique, a certain degree of accuracy can be achieved. We may recall that, when the original pennyweight was defined in terms of grains of wheat, an effort was made to secure uniformity in the grains. A grain of sand, again, sounds to us now far too indefinite to be treated as a standard but Dobell has shown that Grew's contemporary, Leeuwenhoek, had in mind a grain of about $\frac{1}{100}$ in. in diameter, when he spoke of a "fine sandgrain", while a "coarse" grain was about $\frac{1}{30}$ in. In the case of objects seen through the microscope, the difficulty of size-recording was even greater. Grew observed, for example, that the vessels of roots showed a range of about twenty degrees in size, but he had no means of assessing these degrees individually, and all he could say was that "Some [vessels] in the *Vine*, being of the greatest Size ; appearing through a good *Glass*, at least one third of an Inch in Diametre". Grew indeed even resorts to the still more unsatisfactory expedient of naming some object the size of which was recalled by the size of the image as he saw it in its magnified form. For example, he describes the spore-case of the hart's-tongue fern, when seen through "a good *Glass*", as being "about the bigness of a Cherry-stone".

Grew not only tried to give measurements for the objects he describes, but he also recognized that "The *Arithmetick* of *Nature* is every where suitable to Her Geometry", and that the parts of the plant are "as punctually, for their Place and Number, composed together ; as all the mathematical Lines of a Flower or Face". Inspired by such ideas, he made an attempt to work out a mathematical description of leaf shape, on the theory that "all Regular *Leaves*, are defined or measured out by *Circles* ; that is, by the *Arches* or *Segments* of several *Circles*". He thought that the length of the leaf was "the *Standard Measure* for the *Diameters* of these *Circles* ; these being either its full length, or certain equal parts subtracted, or multiplied". As, on the showing of his own figures, it required seven circles to define the simple leaf shape of the Cornelian cherry (*Cornus mas* L.), and as, even then, a large part of the outline failed to coincide with any of the circles, the whole scheme obviously broke down as soon as it was applied. Grew, however, was undoubtedly on the right lines in seeking for a mathematical expression for a physical phenomenon. He could not know that science was not yet in a position to help him towards answers to the questions set by his fertile and indefatigable mind. He was better served by current mathematical ideas when he came to realize that the permutations and combinations of a few characters might open up a range of differences comparable with the great "Variety, a few *Bells*, in the ringing of Changes, will produce". In discussing the tastes of plants, to which great attention was then paid as affording clues to their medicinal virtues, he gave a table showing how many threefold tastes would arise by the combination of ten simple flavours, each of which might be present in at least five distinguishable degrees of strength. He calculates that this would lead altogether to 1800 "sensible and defineable *Variations* of *Taste*".

Grew's appreciation of the importance of the virtues of herbs, with which as a physician he was much concerned, led him on to chemistry. With the aid of an apothecary whom he employed, he did a good many detailed quantitative experiments, setting before himself clear and specific aims. As an example we may cite a single one from among the problems which he tackled; he asks "whether any Plant growing in a Garden or the Field, doth not yield a lesser quantity of Lixivial Salt than another of the same kindred growing on the Sea-Coast; and with what difference?" To answer this question he "took *Garden* and *Sea-Scurvygrass*, of each lb. 1", and found that the former yielded "2 *Drachms* and 1 *Scruple*; the latter, being well washed, 9 *Drachms*, which is more than 4 times as much".

His view of the world as a mechanism not only inclined Grew to mathematical interpretations, but it also led directly to his wholehearted adoption of the atomic theory. He uses the word "principles" as synonymous with "atoms", which he regards as being indivisible, immutable, and of divers kinds. He says that "in the self same analogous way, as the *Letters* of the *Alphabet*, are the *Principles* of *Words*; so *Principles*, are the *Alphabet* of *Things*". He draws the logical conclusion that, if such unchangeable atoms are the structural basis of the world, "the *Formation* and *Transformation* of all Bodies, can be nothing else, but the *Mixture* of Bodies".

Whenever Grew grasped an idea, he did not let it go until he had wrung from it everything that, for him, it contained. The idea of atomicity, and the consequent significance of mixture, led him to certain conclusions which bore no fruit at the time, but which foreshadowed developments in science which did not actually come into being until the nineteenth century. One of these developments was the production of organic compounds in the laboratory: "Art it self", he says, "may go far in doing what *Nature* doth. And who can say, how far? For we have nothing to *Make*; but only to *mix* those *Materials*, which are already *made* to our hands. Even *Nature* her self, . . . *Maketh* nothing *new*; but only *mixeth* all things. So far, therefore, as we can govern *Mixture*, we may do what *Nature* doth." In another passage he is more specific about this hope: "we may be taught to *Imitate* the *Productions* of . . . *Vegetables*, . . . *Mucilage*, *Rosin*, *Gum*. . . . I do not say I can do all this: yet if, upon good *Premisses*, we can conclude this possible to be done; it is one step to the doing of it."

Another corollary, which Grew derived from his notions about atomicity and mixture, was concerned with the sexual process. Though he had never heard of a nucleus, and could not have had any conception of the actual nature of fertilization, he anticipated on general grounds the independence of the parental contributions in the fertilized egg. He emphasizes that "the most *perfect Mixture* of Bodies, can go no higher than *Contact*. For all *Principles* [that is, atoms] are *unalterable*; and all *Matter* is *impenetrable*. . . . In the most *visible*, and *laxe Mixture*, there is *Contact*; and in the most *subtile* and *perfect*, as in *Generation* it self, there is *nothing more*."

Nehemiah Grew's philosophy is sometimes dismissed as though it were merely second-hand Cartesianism; but though he was influenced by Descartes to some extent, it is doubtful if this influence went at all deep. It is significant that he parted company with Descartes altogether on the question of the structure of the universe. He was, as we have just seen, a confirmed atomist, whereas Descartes held the view that atoms do not exist.

Grew's whole personality seems to have been so closely integrated that his biological work, and his attitude to philosophical problems, were inseparably knit together. Great as were his specific contributions to the knowledge of plant structure, we are at least as much in his debt for his analysis of the relation between thought and observation, and for his recognition that the divorce of the two is fatal to scientific work. In his own words: "Thoughts cannot work upon nothing, no more than hands; he that will build an house, must provide Materials. And on the contrary, the Materials will never become an house, unless by certain Rules he joyn them all together. So it is not simply the knowledge of many things, but a multifarious copulation of them in the mind, that becomes prolifick of further knowledge."

OBITUARIES

Sir James Frazer, O.M., F.B.A., F.R.S.

WITH deep regret we record the death of Sir James Frazer, of world-wide fame as the author of "The Golden Bough" and many other studies of primitive beliefs and institutions, which took place at Cambridge on May 7 at the age of eighty-seven years. Lady Frazer died within a few hours of her husband.

James George Frazer was born in Glasgow on January 1, 1854. After graduating at the University of Glasgow, he proceeded to Trinity College, Cambridge, of which he became a scholar, and after being second classic in 1878, was elected a fellow in 1879. He was called to the Bar as a member of the Middle Temple, of which he became an honorary bencher in 1931.

Although Frazer's work in the early years of his tenure of his Trinity fellowship continued to be devoted to the classics—his earliest publication dealt with the Catiline Conspiracy, and he produced an edition of Sallust—his thoughts were already turning in another direction—towards the subject which was to become his main life work, the study of primitive religion. This was due in part to the influence of E. B. Tylor, whose "Primitive Culture" opened up to him vistas of investigation into the workings of the human mind still unexplored, and in part to his friendship with Robertson Smith. It was at the invitation of the latter, when editing the ninth edition of the "Encyclopædia Britannica", that Frazer contributed to that publication the articles on "Totemism" (1885) which afterwards was enlarged to appear in book form as his first separate publication in anthropology (1887). It was also the nucleus from which was developed the comprehensive and world-wide survey of totemism which appeared in four volumes in 1910 under the title "Totemism and Exogamy".

Even before this book appeared in 1887, anthropologists had recognized the appearance among them of a research worker whose investigations might well go far in the advancement of their science. In a discussion which followed the reading of a communication on burial customs by Frazer before the Anthropological Institute and published in the *Journal* of that body (1885), Tylor spoke in high terms of his work and his use of the comparative method in bringing the customs and rituals of classical antiquity into relation with those of primitive and savage peoples. This early paper by Frazer on burial customs will always have significance for the student of his work, for in it will be found the germs of ideas which he developed farther and expanded in subsequent studies. It was evident that he was then formulating the evolutionary concept which underlay his use of the comparative method in dealing with that vast store of evidence which he drew from every available source, whether in the literature of ancient and modern times, or from the researches of anthropological workers in the field, such as John Roscoe of Uganda, Sir Baldwin Spencer or C. G. Seligman, with whom he was in constant touch.

In any attempt to estimate the value and abiding quality of Frazer's work it is important to remember that he himself had in view the aim of building up by his work as a whole a vast picture of the gradual development of the human mind constructed from the interpretation of primitive thought and its survivals, which through the conservatism, the ignorance and the superstition of the unprogressive, had hampered human progress. This conception of the scope and purpose of his work was explicitly set forth in a course of lectures delivered in later years ("Garnered Sheaves", 1931) in which a parallel was drawn between the physical and the mental evolution of mankind. In his pursuit of this objective Frazer gained strength from his ability to view religious beliefs and systems objectively and with detachment. In this he came near the philosophic thought of France, for which he had a profound admiration, as was shown in his Zaharof Lecture on Condorcet delivered at Oxford in 1933. It was, however, Renan with whom was his closest affinity. Not only did he deliver a magnificent address upon Renan before the Société Renan in 1920, but he also gave the address on that thinker before the President of the Republic and the chief notabilities of academic France in 1923 on the occasion of the Renan centenary.

To trace the formative influences which contributed to the development of the mental 'make-up' of one who has, justly, been regarded as one of the greatest intellects of his generation is of more than of ephemeral interest. Indeed, it is owing to failure to grasp the part played by the evolutionary doctrine in the development of Frazer's thought and the full implication of his point of view as a whole, which renders much of the criticism levelled at his work, more especially that his evidence is divorced from its context, wide of the mark.

The first edition of "The Golden Bough" appeared in two volumes in 1890, a second edition in 1900, and after the appearance of revised versions of the several parts from 1905 onward, the third definitive edition in twelve volumes was completed in 1914. Additional matter and further evidence was included in "Aftermath" (1936). Frazer's method of working was to make an exhaustive collection of evidence bearing upon the items in hand, each item being copied into note-books under classified headings. To these entries he added from time to time as new evidence accrued. This practice he continued until nearly the end. After his eyesight failed him in his eightieth year, he, who had always written his books with his own hand, was compelled to make use of the services of an amanuensis. The accumulation of fresh material in this way necessitated in Frazer's view the periodical issue of new, enlarged and revised editions of his major works.

It was one of Frazer's most salient characteristics and a mark of his greatness of mind, that in the true spirit of the exact scientific research worker, he never hesitated to abandon a theory or hypothesis which further evidence showed to be doubtful or untenable. His theories of totemism underwent such revision no less than three times.

The publication of "The Golden Bough" established firmly Frazer's reputation as an anthropologist. He then turned to the completion of his translation and topographical study of "Pausanias", which appeared in 1898. This work necessitated several journeys to Greece, when he became a member of the British School of Archæology in Athens, and gathered material for many an eloquent passage of scenic description in his studies of the religions of the Near East. Further classical studies were a translation of "Apollodorus" (1920) for the Loeb Classics and an edition of the "Fasti" of Ovid in five volumes (1929), in which Roman belief and ritual were illuminated by a wealth of anthropological comparison. In the early 'nineties Frazer was also engaged in making the selection for his "Passages from the Bible chosen for their literary Beauty and Interest" (1895). It was characteristic of his thoroughness that before a second edition appeared in 1909, for the purposes of this and his studies of Eastern religion he had been at pains to acquire a mastery of the Hebrew language. These and other kindred studies served as a preparation for "The Folklore of the Old Testament" (3 vols., 1918).

In 1907 Frazer was appointed professor of social anthropology in the University of Liverpool, a chair which he continued to hold until 1919. Long before the latter year, honours had begun to crowd upon him all unsought, for no great scholar has ever been more modest in regard to his achievements than Frazer. Universities both in Great Britain and on the Continent conferred honorary degrees upon him; in 1914 he received the honour of knighthood; he was elected a fellow of the Royal Society in 1920, and in 1925 the Order of Merit was bestowed upon him. He was also a Commander of the Legion of Honour and of the Order of Leopold of Belgium.

In the years that followed the War of 1914–18, Frazer's activity was ceaseless and indefatigable and so continued almost up to the very end. Studies on his customary comprehensive scale on such topics as the belief in immortality (based upon his Gifford lectures of 1911), the origin of fire, and the like, were major occupations, which did not preclude the preparation and delivery of numerous lectures and addresses, and the revision and issue of several volumes of collected papers. An untiring industry crowded into a few years what for the ordinary worker would have served for a lifetime.

In 1896 Frazer married Mrs. Lilly Grove, a Frenchwoman, and herself an author of versatility and charm. Not only did she do much to spread a knowledge of her husband's work among the general public by preparing abridged editions of "The Golden Bough" and other books, as well as translating or supervising the translation of several of them into French, but also by her constant care for his health and well-being she did a great service to the science of anthropology.

Encyclopædic is the only word applicable to the work of Sir James Frazer, whether one has regard to its range or to its sheer amount. It is paying him the highest of compliments to say that among British anthropologists he ranks next to Tylor. Now Tylor, apart from the unfair advantage of having come first, founded his new science on broader foundations, approaching the subject of man biologically, so that his development in respect to body and mind alike must be studied in its entirety. Even so, he had most to say about man's most peculiar attribute, his culture, both material and moral, as it is embodied in a social tradition; while he duly noted that primitive culture somehow came to a head in a body of notions or superstitions more allied to religion than to science as we know them now. Tylor proceeded to explain—one might almost say, explain away—this ancestral tendency to invoke supra-sensible aids, as applied to the management of mundane affairs, in ways that in the main attributed reasonable, if mistaken, trains of thought to the "primitive philosopher"; he saw ghosts, hence his animism; he made gifts to them, hence sacrifice, and so on. One felt that half-an-hour's chat with a modern man of science might have rationalized human progress from the very start. But the Frazerian as contrasted with the Tylorian "savage" is a lunatic at large, who yet found his lunacy pay, in the supreme sense that nothing pays so well as survival.

"The Golden Bough" introduces us to a topsy-turvy world, in which life's chief values as we civilized folk assess them have to be turned upside down before they make sense for intelligent and successful persons having to wrestle with stone-age conditions. Just then, too, Baldwin Spencer reported from Australia intimate conversations with primitive philosophers, not imaginary but existing in the flesh, who were miserably off in all material respects, and yet spiritually got an immense satisfaction out of life by communing with things to which our science denies all objective existence.

Frazer's account of this preoccupation with a sort of dream-world on the part of pre-civilized peoples engaged in a life-or-death struggle with untamed Nature brings home to all the paradox of this law of indirection governing the human effort to live on and live well, and is his main contribution to anthropological theory. His wonderful style helped, but of far more help is the prodigious wealth of well-authenticated facts at his disposal. Indeed, he theorized half-heartedly, trusting rather to the wholesale thrust of the evidence in a direction which never varies. There is no attempt to edify. If anything, he was a rationalist, impatient of all this leaning towards the fantastic—which is the imaginative or the imaginary as you please—on which our race has hitherto been prone to rely. But he had the respect of the true man of science for his data. If this truly was so, then no less truly that is the queer kind of animal to which we belong.

This tremendous apparatus of empirical evidence will be Frazer's lasting monument. Accumulative, perhaps, in the first instance rather than constructive, yet in its whole result it is creative work of the superbest magnitude. That man's visions afford the leading clue to his cultural evolution could only be demonstrated massively, and he has done it.

R. R. Marett.

When studying at Glasgow, Frazer owed much to George Ramsay in classical scholarship, and to John Veitch in philosophy; and to both a literary training and finished style which partly explains the wide popularity of his very learned writings. From Kelvin he derived a conception of natural law, which dominated his anthropological thought. His first contribution to learning, after a revision of Long's "Sallust" (1884), was an encyclopædic commentary on "Pausanias", for which he had prepared himself by diligent travel in Greece, and intimate acquaintance with the by-ways of Greek myth and cult. This appeared in six volumes in 1898; Frazer was never brief, and he recurred to classical study in five volumes on "The Fasti of Ovid" in 1929.

Meanwhile, James Ward introduced Frazer to Tylor's "Primitive Culture", and Robertson Smith asked him to write on "Taboo" and "Totemism" for the "Encyclopædia Britannica" (1885); these articles were extended and published separately in "Totemism" (1887). Robertson Smith's own "Kinship and Marriage in Early Arabia" (1885) and "Religion of the Semites" (1889) show how much each writer owed to the other. Other powerful influences were W. Mannhardt's researches in European folk-lore, especially the cults of trees and cereals, and G. A. Wilken of Leyden, whose book on "Animism" in the Dutch Indies appeared in 1885. So, in 1890, blossomed the first "Golden Bough" in two volumes, growing to three in 1900, and to eleven in 1911 by elaboration of its chapters into treatises such as "Adonis, Attis, and Osiris" (1906), in many ways his best book, and certainly the best written. Later writings followed the same technique; from a branching tree "The Golden Bough" became a grove; "The Belief in Immortality" (3 vols., 1913–24), "The Worship of Nature" (1926), and "The Fear of the Dead" (2 vols., 1933–34) are mighty saplings.

This method of exposition enabled Frazer to incorporate voluminous information and fresh commentary in a cumulative body of doctrine. If his initial contribution to theory had not been substantial, or had he modified it greatly, it could scarcely have served him so well.

Frazer was an untiring compiler and a master of classification, and his marriage with Mrs. Lilly Grove, of French family and linguistic ability, brought him life-long, devoted and congenial help, introduced him to a wide circle abroad, and did much to popularize his work at home. From 1907 until 1919 he held a titular chair of anthropology in the University of Liverpool, where his eloquent inaugural, a plea for the preservation of the heathen, caused some heart-searching; as did his abrupt refusal to lead an anthropological expedition to Australia, "for I have never met a savage in my life". But most of his working life hovered between Cambridge and London.

More philosophical than most of his writings, and less meticulously documented, is "Psyche's Task" (1909; 1913), a "discourse concerning the influence of superstition on the growth of institutions"; while "Folklore in the Old Testament" and the "Fasti" already mentioned are essentially books of reference like the "Pausanias". In Dr. Bestermann's bibliography of eighty-four pages (1934) titles referring to Plato, Addison, Cowper, Sir Roger de Coverley, Condorcet and Renan attest wide literary interests and a facile pen. Failure of eyesight did not abate Frazer's industry or enthusiasm; but he printed little after 1934.

J. L. Myres.

Sir James Frazer was the personification of quiet industrious scholarship, very little moved by the vast accumulation of honours which came to him, and sometimes almost bewildered by publicity. His interest in religious matters was a key to a good deal in his character and work. Having begun by expounding classical culture as a growth and expansion from prehistoric germs, he was deeply and reverently imbued with the idea of evolution in religion in general. The fact that so many religions in such diverse ways express a consciousness of sin seemed to him an important factor in the interpretation of religion in general. At the same time a good deal of his critical influence arose from his appreciation of the fact that stories of virgin birth, resurrection and other ideas of the kind belonged to many religions and expressed provisional ideas rather than authoritative dogmas to be permanently associated with any one religion.

He often explained that he was essentially the disciple of Robertson Smith, whose "Religion of the Semites" stands out as one of the landmarks of the advance of thought in this field. His laboriousness was linked with a literary power of a high order and a purity of thought which made him a unique and somewhat detached figure in our time. He might be described as a man who extended Darwin's fundamental thought into the field of religious belief and practice, and his influence here is likely to be cumulative as the years pass. Particular conclusions that he may have reached from time to time were changed as he gained more light, and they will no doubt be further changed. His work may thus be built over, but it is Robertson Smith and Frazer who have in a very special degree charted the way to a new and naturalistic approach that must change many things in current thought and belief.

H. J. Fleure.

When Sir James Frazer's coffin rested in Trinity College Chapel on May 14, it was most fittingly graced with a bough of mistletoe. For if of Sir James's three hundred or so publications "The Golden Bough" alone had survived, his fame would be only a little less than it is, and were "Totemism and Exogamy" added to that, all the rest could make it but a little greater. Although we should miss the charm and humour of his purely literary works, his reputation as a man of letters would be as fully established by, say, the opening pages of "The Golden Bough" as his fame as a scholar is attested by the volumes that follow them. Frazer, though always a man of letters, and one who has adorned the literature of his country with many passages of surprising beauty, was primarily a scholar, and his great service to posterity has been in collecting and collating, with a steadfast industry that defied both flagging health and failed eyesight, a compilation, a series of compilations rather, of comparative custom and belief for the whole of the barbaric world, ancient and modern alike.

Inspired as he was by Tylor, Spencer and Robertson Smith, Frazer was inclined himself to the evolutionary hypothesis that mankind was ever groping out of darkness into light, everywhere evolving from ignorance through experience to completer knowledge, a process which inevitably produced similar phenomena at comparable stages. Although he frequently analysed the grounds of these phenomena with great acumen, he was always most careful to avoid dogmatizing, and, as one might expect in a truly great man, his modesty was as striking as his scholarship was profound. Indeed, he said himself that if his work were to live after him, posterity would doubtless value it more for its wealth of recorded fact than for any interpretations he might draw therefrom. The truth is that his comparative work has been so extensive that it has left little to be done in that particular field, and anthropologists of a subsequent generation have taken its results for granted without always realizing their debt to the work which has cleared the way for the development of their science in many new directions. Anatole France well said of Frazer that he had given the world a vast new knowledge of the mind of man.

J. H. HUTTON.

Prof. C. G. Cullis

RESPECTED by all who knew him, held in affection by his former colleagues, and revered by generations of students, Prof. C. Gilbert Cullis, emeritus professor of mining geology in the University of London, died at Hindhead on April 27 at the age of seventy.

He had been a member of the staff of the Royal School of Mines and the Imperial College of Science and Technology for forty-five years, and on his retirement in 1936 had completed nearly a quarter of a century as professor, from 1914 until 1929 as professor of economic mineralogy and from 1930 until 1936 under the more descriptive title of professor of mining geology. With Prof. W. W. Watts as geologist, and Prof. Cullis as mining geologist, the training of students at South Kensington became world-famous.

Cullis was the first professor appointed by the University of London in a subject which had its birth in the growing need for the application of geological knowledge to the investigation of mineral resources, especially at depths greater than had formerly been worked. He realized early and fully that accumulated experience in the field, not spectacular intuition, was the best guide to sound judgment concerning ore deposits, and he made himself familiar with many mining fields in Europe. He established a great reputation, and leading British mining companies frequently sought and highly valued his advice. It was largely due to his influence that these companies and Colonial Governments initiated the practice, now well established, of appointing mining geologists on their staffs, and students trained by him were in strong demand. Thus he made a solid contribution to the advancement of the industrial application of scientific knowledge and much of the progress of modern British metalliferous mining is in large measure due to the success of his former students, many of whom now occupy foremost positions in the mining and geological world.

His chief publications were: "Report on the World's Production of Silver for Indian Currency". (1919), "Report on the Copper Deposits of Cyprus", for the Colonial Office (1922), and the "Geology and Mineral Resources of Cyprus" (1924). Valuable as are these clear, concise and erudite reports, his chosen task was the training and encouragement of his students. Gifted with a prodigious memory which enabled him to acquire an encyclopædic knowledge of the world's mineral deposits, with great command of language, clear diction, capacity for taking infinite pains, and with a delightful personality, he was acknowledged to be one of the most successful teachers of his day. His past students never failed to pay tribute to their inspiring mentor, and on his retirement hundreds of them, resident in almost every country in the world, took the opportunity of contributing to his presentation fund. It was characteristic of him to give the fund for the establishment of an annual student's prize, now known as the Cullis Prize.

Cullis was for many years a member of Council of the Geological Society and of the Institution of Mining and Metallurgy, and the two bodies bestowed upon him some of their highest awards. He was president of the Institution of Mining and Metallurgy for 1937–38. More, however, than all distinctions, his supreme interest was in the performance of his daily work, which he interpreted as giving his best to his students and his colleagues.

W. R. JONES.

WE regret to announce the following deaths:

Mrs. Beatrice Bateson, widow of Dr. William Bateson, F.R.S., on April 13.

Prof. Edmond Leplae, professor of agriculture in the University of Louvain and director-general at the Belgian Ministry for the Colonies, on February 2.

Sir D'Arcy Power, K.B.E., the well-known medical historian, consulting surgeon and archivist to St. Bartholomew's Hospital, on May 18, aged eighty-five.

The Earl of Suffolk and Berkshire, who was liaison officer for the scientific department in France of the Ministry of Supply, until the collapse of France, by enemy action, aged thirty-five.

NEWS AND VIEWS

Hanbury Medallist of the Pharmaceutical Society

At the May meeting of the Council of the Pharmaceutical Society the secretary reported that the adjudicators of the Hanbury Medal have decided to make the award to Dr. Harold King, F.R.S., of the National Institute for Medical Research. Dr. King, has been engaged in research on drugs since 1913, and apart from important work on synthetic arsenical preparations, has made outstanding contributions to the chemistry of alkaloids and sterols. Of his work on alkaloids special mention may be made of that on the constitution of hyoscine, the stereochemistry of the cinchona alkaloids and the exhaustive investigation of the sources, nature and constitution of the alkaloids present in the various kinds of curare and in the plants known or surmised to be used in the preparation of that drug. In 1932, in association with Rosenheim, Dr. King suggested a new structure for the cholane ring system which is now generally accepted as a basis for the representation of a number of physiologically active substances, such as the œstrogenic hormones, carcinogenic hydrocarbons and cardiac glucosides. The Hanbury Medal, a memorial to Daniel Hanbury, who died in 1875, is awarded periodically for "high excellence in the prosecution or promotion of original research in the natural history and chemistry of drugs". The adjudication committee comprises the presidents for the time being of the Chemical, Linnean and Pharmaceutical Societies, the chairman of the British Pharmaceutical Conference and one pharmaceutical chemist.

Royal College of Surgeons: Air Raid Damage

Considerable damage has been done to the Royal College of Surgeons in recent air raids. According to *The Times* "irreparable losses, including most of the Hunterian Collection, were suffered. Incendiary bombs first fell on the roof of the building, but just as a watcher was giving the alarm a high-explosive missile struck the museum. In spite of great damage to the interior the fabric of the College is more or less intact, but the museum buildings have suffered severely. The most valuable specimens in Dr. John Hunter's collection, purchased by the Government for £15,000 two years after his death in 1793 and presented to the College, are probably safe under the debris, having previously been moved into reinforced sections of the sub-basement. The collection of portraits and pictures, including Reynolds's portrait of Hunter, are safe in the country, and the part of the records still at the College had been stored in strong rooms that withstood the blast and flames.

Thousands of museum pieces are gone, among them the skeletons of kangaroos brought by Captain Cook from Australia, and the comparative osteology collection of four thousand specimens acknowledged to be the finest in the world. Much of the material ante-dated British Museum specimens. All Dr. Hunter's eighteenth-century furniture, which was in the president's room, was destroyed. The original surgical instruments used by Lister were recovered, but many others were lost. Though the oldest mummy in the world, that of Ra Nefer, an Egyptian nobleman who died, it is said, about 2900 B.C., was destroyed, many mummies of popular interest have been salved. The invaluable Army Medical War Collection, containing plaster casts of every type of wound, was also destroyed, as were the council room and lecture theatre.

Science and Society

An address entitled "The Social Message of Science" was delivered by Prof. M. Polanyi at the University of Leeds on January 27. Prof. Polanyi in Nature of January 25, p. 119, expounded at length views which he summarized in part. He sees clearly enough what is involved in the present struggle: scientific workers must participate to defend the independence of science and all the conditions of that independence, the whole conception of culture, of law and of the purpose of society which can assure such independence. He recognizes, too, the concern of science with the entire order of society, political and economic, which affects its independence and the contribution which science can offer to the re-civilization of the world, through the example of the creative freedom sheltered by its severe professional discipline or by stimulating severity against mental sloth and deceitful argument, thus releasing a stream of creative forces. But while Prof. Polanyi holds that science has a social message, he is obsessed with the independence of science itself, and his rejection of all ideas of central planning of science and other human activities does not lead to the offer of any constructive alternative to the anarchy into which the failure to plan or co-ordinate scientific advance has led us. This obsession leads him to confuse all who attempt the central planning of intellectual activity with those who deny the existence of pure science. There are, however, many opponents of the totalitarian doctrines who none the less question the validity of distinguishing sharply between pure and applied science, but would subscribe to Prof. Polanyi's characterization of science itself as pursued in adherence to an established tradition of its own, which guides the methods of observation and the principles for analysing and organizing the accumulated data.

Prof. Polanyi's attempt to drive a wedge between the academic man of science and the scientific worker in industry is no service to science, above all when the utmost united effort is called for in the defence of freedom of thought and investigation. Much, indeed, of his analysis of the nature of science is as true of the scientific worker in industry as of his colleague in a university. The same process of organic growth can be found in both places—and, what Prof. Polanyi overlooks, the same narrow specialization, hampering scientific advance and creative work. He does indeed admit that public interest can influence broadly the lines of scientific investigation, but he passes over the value of the reciprocal influence on both science and society of accurate and forceful scientific exposition, as well as the extent to which the resources already at the disposal of science are determined by the nature of the society in which the man of science lives and its outlook on world affairs. Prof. Polanyi is accordingly largely 'tilting at windmills' in his attack on the idea of central planning. He offers no alternative to the present chaos into which the absence of plans has led us, and ignores the contribution which skilful exposition might make to the engendering of a scientific outlook in society as a whole. Much of the value of his address is lost through its attack on those who are every bit as determined as he is to defend the integrity of scientific thought and method, but who would seek to extend the realm into which that method and outlook are brought to play. Leadership, as he observes, can be retained only by those who can point the way toward the future; but Prof. Polanyi fails to do so or to see the real meaning of his own description of the stream of thought ever widening through the centuries, following steadily the purpose set by the tradition of science and its view of the purpose and true greatness of human society.

Manufacture of Magnesium

It is common knowledge that sea-water contains common salt and small quantities of other substances and even traces of rarer elements such as gold. Throughout the ages, in warm countries, a crude sale has been made by the evaporation of brine ponds with the heat of the sun, but only recently has the sea become a commercial source of two other constituents, bromine and magnesium, for which the industrial demand has grown to be considerable. The demand for bromine arose as the result of the discovery of the value of 'Ethyl' as an antiknock agent to be used with petrol: its manufacture and use has grown to a point where very large quantities of bromine are necessary. The problem was solved when the Dow Chemical Company in the United States established an elaborate process, which is largely automatic and continuous in its operation, for dealing with immense quantities of sea-water. The bromine is driven out of the water by a slight excess of chlorine and ultimately isolated. The solution is one of the triumphs of modern chemical engineering.

There is now a demand for magnesium, lightest of the structural metals. Sea-water contains 0·1 per cent of magnesium, which is separated as the insoluble hydroxide by reaction with lime produced from nearby beds of oyster shell and afterwards converted into chloride, from which the metal is finally made by electrolysis. The quantity of water treated is so large that it cannot be put back into the sea at the intake point, but must be taken by canal several miles down the coast so as to prevent dilution of the incoming water. An output of 15,000 tons of metal per annum is aimed at. The need for magnesium in quantity has become so urgent that several plants for the purpose are being erected in the United States. Some of these are based on an electro-thermal process involving the reduction of a suitable magnesium ore. The metal has such a high affinity for oxygen that at intermediate temperatures it is able to take this away from carbon oxides; to prevent this happening, the mixture has to be shock-cooled with large volumes of hydrogen. The process is a daring one, and various production difficulties are likely to be encountered; the fact that it is being undertaken shows the high level to which modern chemical and metallurgical engineering has attained. In this instance ore and electrical power are cheap; it is the process which presents difficulties.

Learning and Physique

Of one hundred and fifty members of the U.S. National Academy of Sciences examined by Dr. Aleš Hrdlička, there were "no true reds" (*Mem. Nat. Acad. Sci.*, 23, Third Mem.: Observations on the Members of the National Academy of Sciences. Washington: Government Publications Office. 30 cents). Moreover, there were no "pronounced blonds". Apparently, the members of the Academy were significantly darker in hair coloration than were the typical "Old Americans" previously examined by Hrdlička. The mean age of those upon whom the investigation was carried out was 59·57 years, which is very nearly the mean age of the total membership of the Academy. The hundred and fifty members were taller and heavier than the general run of the Old Americans. They had larger and broader heads and deeper chests than the more cultured classes of the Old Americans who are not members. Hrdlička's summary of the characters of members of the Academy is that: "They obviously present, in general, an above-the-average selection of men both as to nature and nurture. . . . They are furthermore a remarkably normal group, of evidently good heredity and good ontogenetic history". Contrary to the popular conception of what a 'professor' should be, there were no "physically abnormal geniuses in the lot", and all had good eyesight, despite the fact that many wore glasses for reading.

Perhaps most people in picturing the collective membership of any learned society would be inclined to include a very definite admixture of freaks. Such a picture of the members of the National Academy of Sciences would obviously be incorrect. Would it be incorrect for the membership of the Royal Society? Are the members of the learned societies of all countries men of above the average of physical well-being? Perhaps, after all, the old maxim of "*mens sana in corpore sano*" is correct, and the stage professor no more represents a reality than does the stage American.

Telephones in Canada

Canada now probably takes the lead of every country in the world in the number of completed telephone calls a head, and considering the total number of telephones in use, it ranks fifth (*Electrician*, April 25). The total number of telephones in Canada showed an increase of about three per cent above 1939. In that year approximately 68 per cent of all instruments were residence telephones; 30 per cent were business and residence telephones on individual lines; while two-party lines accounted for 2 per cent. Nearly half of the telephones in operation in Canada in that year were on automatic switchboards, while during the year some 50,000 telephones were transferred from manual to automatic operation. In 1939, Canada had 12·35 telephones per 100 population as compared with 12·13 in 1938. In 1938 Canada was surpassed only by the United States with 15·37, Sweden with 12·73 and New Zealand 12·69 telephones per 100 population.

The number of telephones on automatic switchboards in Canada increased from 639,700 in 1938 to 690,201 in 1939, while the number of manual switchboards declined from 719,717 to 707,071. The majority of the automatic telephones are located in fifty-one large cities. During 1939 telephones added or transferred from manual to automatic switchboards in these cities totalled 40,769, as against 9,732 in other municipalities.

Health of Glasgow

In his latest report Dr. A. S. M. Macgregor, the medical officer of health for Glasgow, states that the lower death-rates and the reduction in the incidence of common diseases in 1939 recall the experience of London and other cities in that year, but in 1940 Glasgow showed some disquieting features. The general death-rate during 1939—13·3 per 1,000—was the lowest on record. There were fewer deaths due to respiratory and infectious diseases. Infantile mortality fell to 80 per 1,000 births, the usual range being between 90 and 100. Deaths due to puerperal infection numbered 30 as compared with 50 the year before. During the first quarter of 1940, however, there was an outbreak of influenza, and by the end of January the death-rate had risen to 41·1 per 1,000 of the population. There was also an outbreak of paratyphoid fever with 274 cases but only 3 deaths. For the first time for many years measles was prevalent in the summer instead of in the winter. In the later part of 1940 diphtheria in Glasgow, as in some other parts of the country, reached its highest prevalence. Apart, however, from the influenza attack and the prevalence of diphtheria the health of Glasgow was almost as favourable in 1940 as in 1939.

Earthquake in Atlantic Ocean

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the provisional epicentre of the earthquake of March 21, 1941, which took place at 7h. 58·4m. G.M.T. This they have found to be at latitude 7·3° N., longitude 38·6° W., which is in the Atlantic Ocean to the north-east of Brazil. The calculations were based on reports from the seismographic stations at Manila, San Juan, Fordham, Huancayo, Philadelphia and Logan, and it is suggested that although the depth of focus is to some extent uncertain, yet it may be of the order of 100 km. Earthquakes in this region are somewhat rare though they are frequently experienced in certain parts of the West Indies; but an earthquake of deep focus in this region is certainly a more rare occurrence, if not entirely without precedent.

Johan August Hugo Gylden (1841-1896)

On May 29 the centenary occurs of the birth of the eminent Swedish astronomer, Hugo Gylden, who for many years was director of the Stockholm Observatory. Gylden was the son of the professor of Greek at the University of Helsinki, and he received a careful training under his father. He also studied at Gotha and Leipzig, and at the former place came under the influence of Hansen. At the age of twenty-one he entered Pulkowa Observatory, and there, under Struve, began his investigations on the orbits of comets and planets. Nine years later he was called to Stockholm as director of the observatory and astronomer to the Royal Academy of Science, and he retained these appointments until his death on November 9, 1896. His papers exceeded two hundred in number, and related to the motion of planets and comets, the rotation of the earth, stellar parallax, refraction, mathematical analysis, cosmogony and other subjects. In 1879 he succeeded Secchi as a corresponding member of the Paris Academy of Sciences. He was made an associate of the Royal Astronomical Society, to which an obituary of him was contributed by his most famous pupil, Backlund.

Announcements

Sir Arthur Keith, lately Hunterian professor of the Royal College of Surgeons, has been elected a foreign associate member of the U.S. National Academy of Sciences.

Dr. Philip R. White, of the Rockefeller Institute, Princeton, has been awarded the Stephen Hales Prize of the American Society of Plant Physiology for his work on plant tissue culture.

The Scientific Instrument Manufacturers Association of Great Britain, Ltd., of 60 Queen Victoria Street, London, E.C.4, has founded a scholarship in optics at the Imperial College of Science, South Kensington, up to £40 per annum, for a minimum of two years. The scholarship will be awarded immediately a suitable candidate presents himself.

Erratum. In the article "The Man of Science as Aristocrat" (Nature, April 19, p. 465), for "the great lens" of the Lick Observatory read "the great mirror".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

International Democracy of Science during War and Reconstruction

THE central idea of this communication can scarcely be claimed as original or new, but its brief draught has been stimulated by witness of the work of British men of science, admirably continued during these times. Monographs and other volumes, articles of academic or applied scientific nature, and reviews and surveys emanating from Great Britain continue to impress us in the United States with the capacity of British men of science for production of quality under the extreme conditions imposed by modern warfare. Touching on the personal side, recent letters from university friends in England, current publication, without undue delay, of papers written jointly with colleagues in that country, and numerous leading articles appearing in recent issues of NATURE have all afforded me a projected conception of the sane tempo of British scientific activities.

War has paralysed scientific progress in several countries victimized by military aggressors. It has in many ways hampered the activities of scientific centres in Britain. The same conflict is exerting its effects upon American institutions through selective service and the application of increasing thought and research activity to programmes of national economic and military importance.

Years of strife lay stress upon the prime importance of emphasizing in a substantial way the international democracy of science. The responsibility of maintaining this desired status, that progress may resume its full dimensions at the earliest opportunity, lies in the hands of those stronger nations, whose government is by the people. We of the English-speaking countries have as one of our many inevitable co-operative tasks that of implementing recovery from intellectual starvation in those nations whose ideals we share but whose resistance was unfortunately inadequate to stand off the aggressor.

Repair and expansion of the broad highway of learning may be served in several ways during war, to the end that eventual reconstruction may be accelerated among all peoples, affording widening horizons for greater numbers and the furtherance of human well-being and mutual understanding.

Some suggestions for realizing this programme in part during war-time are: increased exchanges of scientific publications, the transmission of more invited and voluntary contributions to foreign journals, and the establishment of additional international journals. A few international journals, published in the United States, supported by capable agencies in democratic countries and having on their editorial boards personnel in and serving the same respective countries, should constitute additional outlets for the publication of scientific work in the event that war conditions continued to increase restrictions already operative. Worthy contributions would be welcome from all scientific investigators who shared the faith in such instruments' *raison d'être*. Nobody is unaware of the deadly factors which militate at present against the successful projection of such a programme. Nevertheless, permitting the defeatists' condemnation of our efforts as mere Utopianisms to befog vision or block action cannot be tolerated. Rather, should not every appeal be made to respective agencies within the free democracies to investigate feasible ways of aiding in the realization of the objectives ?

The much-discussed matter of international exchange professorships could be given support with inestimable profit. In war-time, such exchanges should apply chiefly on a unilateral basis, to enable older or certain highly specialized citizens of involved countries to visit non-belligerent nations, or nations in a state of conflict but removed geographically from the immediate theatre of war. Indeed, the years just preceding this war, and the time elapsed since its inception, have seen the compulsory emigration of a great number of scholars from their home countries, later to find themselves settled, at least temporarily, in free democratic States where a measure of their work may be continued. Admitting that the accommodation of refugees gives rise to numerous problems, it must at once be recognized that the temporary refugee fulfils potentially an important dual function. He brings to the host-country some of his own culture and philosophy and will eventually take home to his own people new views and ideals gained from his sojourn abroad. He thus constitutes one fortuitous and effective means towards the integration of human thought and international understanding.

At the end of hostilities, a point of great importance would be the encouragement and development, on the bilateral exchange basis, of younger investigators especially. Such a plan, brought into extensive operation during the period of reconstruction, would benefit the cause through the advantages offered to the exchange visitors themselves, as well as to their colleagues and students, resident and foreign. Arrangements might be made feasible whereby each home university or other institution would continue to pay the salaries of its delegates, while funds for defraying the expenses of travel might be furnished by university groups, governmental departments or larger private organizations which normally foster foreign fellowships and scholarships.

I held a fellowship which made possible my spending the year between September 1938 and September 1939 at an English university. That experience, with its opportunities for study among stimulating colleagues, and the ever-new adventures in friendship and understanding, has been the prime factor in deepening my convictions summarily expressed in this communication.

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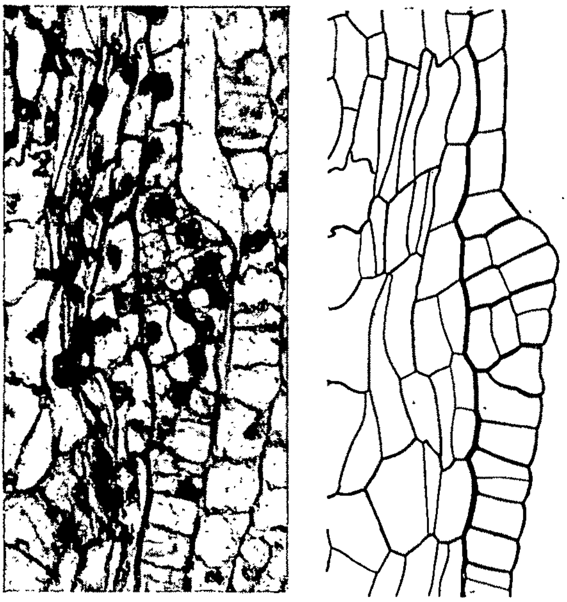
April 5.

Development of the Ligule in *Zea Mays* L.

During an investigation of leaf initiation and apical organization in grasses, some particularly clear stages in the origin of the ligule were seen in young leaves of maize shoots cut longitudinally in the plane of the leaves. The development of the grass ligule has received attention from only a very limited number of workers (Bugnon[1,2], Ponzo[3], Philipson[4], and Neumann[5]), but all agree that it arises solely from the young epidermis. Neumann well summarizes its origin when he says "The ligule of *Zea Mays* arises from three horizontal rows of epidermal cells lying one over the other".


A *B*

(× 780 approx.)

The photomicrograph *A* and the cell-wall drawing *B* show part of a leaf, about the fifth from the apex, in a maize shoot, and illustrate the way in which the ligule is initiated by rapid periclinal divisions in a few young, rather more densely staining, epidermal cells at the union of the future lamina and sheath. Although periclinal divisions in the sub-epidermal cells accompany the divisions of the epidermal cells, the continuity of the sub-epidermal cells under the ligule and the similar continuity of the rather thicker original lower wall of the epidermal cells indicate that the tissue of the developing ligule is derived solely from the epidermis.

In all of rather more than twenty species of grasses with the simple membranous type of ligule (or *reine Hautligula* of Neumann) which I have examined, the origin is similar to that described for Zea, though it is often difficult to determine how many horizontal rows of cells are involved.

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Bracken Compost

In two papers previously published[1] attention was directed to the remarkable effects produced on the growth of young trees by the use of organic composts made from straw and other materials.

In the first instance these composts were used to promote growth of various species of pine on poor heath soils of the Bagshot type. Afterwards, they have been applied with equal success to a number of conifers other than pine, Norway and Sitka spruce, larch, Cupressus sp., etc., as also to birch and beech, and their use extended to various types of soil.

Among the materials tested recently with successful results as a basis for similar composts is bracken, from which has been prepared a compost giving highly satisfactory experimental results in tree nurseries and in the corresponding pot cultures with transported soil. In view of the desirability of eradicating bracken under certain conditions and the accumulation of cut fronds resulting from the methods recommended for that purpose, it seems of some interest and importance that experimental results proving the value of bracken compost should be put on record without further delay.

The methods for making composts successfully used in forestry experiments were described in the first of the papers cited. A standardized product was obtained in every case by careful attention to the size, packing and moisture content of the heaps, with addition of nitrogen at the rate of 1 per cent of the dry weight. The amount of nitrogen has been since reduced to ½ per cent in certain composts without loss of quality, and a bracken compost prepared in this way is at present under comparative observation.

Various sources of nitrogen have been employed, by far the most successful being commercial 'dried blood'. The use of simple inorganic salts of nitrogen such as ammonium sulphate or ammonium phosphate has given composts of inferior quality for forestry work. Under war conditions a satisfactory organic substitute for 'dried blood' can doubtless be found. The successful use recently by Waksman[2] of definite proportions of alfalfa with straw as a basis for composting is worth noting in this connexion.

Bracken compost heaps made as described develop a high temperature and show a well-marked thermophilic phase during decomposition. They break down quickly giving a sweet-smelling friable compost easy to handle. Its value for crops other than young trees requires to be tested.

A recent paper by Braid[3] on bracken eradication recommends cutting down of the fronds in June. Comparative experiments with composts made from dead fronds cut in October and from green fronds cut and dried in early July have given results slightly in favour of the green product, and these results could doubtless be extended to cuts made rather earlier in the summer if found desirable.

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Radioactive Copper and the Mechanism of Oligodynamic Action*

INASMUCH as the stimulation of organisms by extremely low concentrations of heavy metal ions (oligodynamic action) is a well-known phenomenon, it seemed desirable to use the artificially radioactive isotope $_{29}Cu^{64}$ (Cu*) to enable one readily to determine the fate of the radioactive copper added to cells in concentrations of the order of 10^{-10} moles per litre.

The leaves of *Elodea canadensis* were immersed in 10^{-6}, 10^{-8}, and 10^{-10} *M* solutions of Cu^*Cl_2 (radio copper kindly supplied by Prof. E. O. Lawrence; the activity of samples was about 10 millicuries per gram) dissolved in quartz-distilled water maintained at 25 ± 0·1°C. in a thermostat and constant carbon dioxide free aeration was supplied. The *p*H was 6·8 ± 0·2 and illumination was diffuse daylight of the order of 5 metre-candles. After required times of immersion, a known weight of leaf material was washed in 500 volumes of distilled water and analysed by the Geiger-Müller counter. The data are shown in the accompanying table. Here it can be seen that while the external concentration of Cu++ is so low that it is difficult to imagine its exerting a physiological effect, nevertheless, in the cell this concentration reaches a very substantial value, exceeding the external solution by almost 3 × 10^8 times at its maximum value. It can be further noted that the organism tends later to eliminate the accumulated radioactive copper and that the rate of uptake of this cation depends upon its concentration. The data for 10^{-8} *M* Cu* solutions are not presented, but they fall substantially between the 10^{-6} and 10^{-10} *M* values.

External concentration (moles/litre)	Cu* concentration in Elodea. (moles/kgm. protoplasm)	Ratio of Cu* inside/outside	Time (hr.)
10^{-6}	0·012	1·2 × 10^4	0·5
10^{-6}	0·050	5·0 × 10^4	1·0
10^{-6}	0·125	1·2 × 10^5	2·0
10^{-6}	0·020	2·0 × 10^4	6·0
10^{-10}	0·019	1·9 × 10^8	2·0
10^{-10}	0·029	2·9 × 10^8	6·0
10^{-10}	0·015	1·5 × 10^8	7·6

These concentrations were found to be physiologically effective, as shown by a comparison of the oxygen consumption of control and Cu++-treated leaves. The effect observed was an increase in metabolic rate. This observation, combined with the failure of distilled water to remove the accumulated radioactive copper, indicates that ions are actually bound in the cell. This bound Cu* cannot be readily exchanged for alkali ions supplied externally, but does readily exchange for Cu++ or Au++. This was shown by placing Elodea in radioactive copper solution for one hour and then transferring to copper, sodium or gold solution and measuring the loss of radioactivity.

It is concluded that copper, in extreme dilutions, exerts its physiological effects by virtue of the power of protoplasm to bind ions against a concentration gradient, so that the concentrations actually present are relatively high. These concentrations later decrease in the cell, and the physiological effect of the heavy metal ion disappears concomitant with this decrease in concentration.

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University of Rochester,
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Structure of Vitreous Silica

DURING the last fifteen years, the diffraction of X-rays by vitreous silica has been the subject of many investigations. Parmelee, Clark and Badger[1] obtained one band with a spacing of 7·1 A. and a faint one corresponding to 2·5 A. Randall, Rooksby and Cooper[2] obtained one band at 4·33 A. with copper *Kα* radiation, while with molybdenum *Kα* radiation another faint band at about 1·5 A. was observed. They believe that the faint band obtained with molybdenum *Kα* radiation is spurious and that the only one on which reliance can be placed is that at 4·33 A. Warren, Krutter and Morningstar[3] obtained one principal band at $\sin \theta/\lambda = 0{\cdot}122$. Using an ionization spectrometer, Hartleif[4] obtained two principal bands at $\sin \theta/\lambda = 0{\cdot}06$ and 0·122 respectively. In view of the widely inconsistent results reported by different authors, the structure of vitreous silica appears interesting and worthy of thorough study. The present investigation gives results which differ in many respects from those of previous workers.

With copper *Kα* radiation two series of photographs have been taken. For one series, a Debye-Scherrer camera was used. The specimen was ground in a mortar to a fine powder and then made into the shape of a cylindrical rod. For the other series, the pinhole transmission method was used. In this case the specimen consisted of a thin plate polished down from the lump to a thickness of about 0·5 mm.

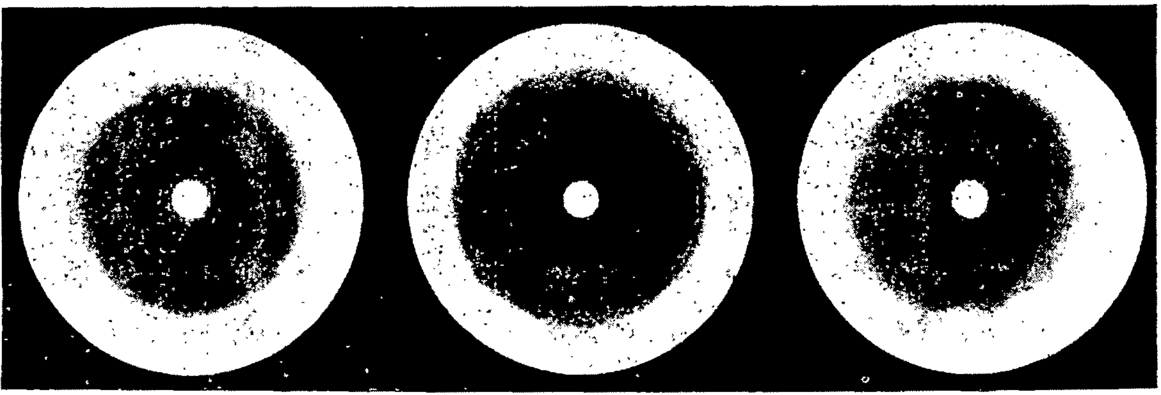
It is rather astonishing to find that the two series of experiments do not give exactly identical results. The Debye-Scherrer photographs show that the diffraction pattern has in general two strong bands *A* and *B* and a series of weak bands *c*, *d*, *e*, *f*, *g*, *h*. The weak bands are so faint and diffuse that they can be recognized only with the utmost care. In certain cases, faint sharp lines l_1, l_2, l_3 appear together with the diffuse bands. Band *A* may sometimes disappear even with the same specimen. The cause of this change is still unknown and is probably some sort of aging effect. With the pin-hole transmission photographs we always obtained two bands *O* and *B*, the relative intensities of which may, however, vary widely with different specimens. Two typical transmission photographs are shown in photographs *a* and *b*.

The accompanying table shows the positions of the bands and the lines and their corresponding spacings (*d*) calculated according to Bragg's law.

	θ	$\sin^2 \theta$	(*h*, *k*, *l*)	*d* (A.)	$\sin \theta/\lambda$
O	5° 04′	0·0088	1 0 0	8·18	0·061
A	7° 37′	0·0176	1 1 0	5·80	0·086
B	10° 50′	0·0353	2 0 0	4·09	0·122
l_1	13° 16′	0·0527	2 1 1	3·35	0·149
l_2	18° 06′	0·0965	3 1 1	2·48	0·202
l_3	24° 08′	0·1671	3 3 1	1·88	0·266
c	32° 41′	0·2916	4 4 0	1·42	0·351
d	39° 29′	0·4043	6 3 1	1·21	0·413
e	52° 44′	0·6333	8 2 2 , 6 6 0	0·96	0·517
f	59° 53′	0·7482	9 2 0 , 7 6 0	0·89	0·562
g	69° 43′	0·8798	10 0 0 , 8 6 0	0·82	0·609
h	75° 58′	0·9412	9 5 1 , 7 7 3	0·79	0·630

It is clear from the above table that our transmission photographs agree exactly with Hartleif's spectrometer results. Most probably the band observed by Randall is really our band *B*, although the value 4·33 A. given by him differs from 4·09 A. by an amount which is beyond experimental error. We failed to identify the band corresponding to 7·1 A. reported by Parmlee, Clark and co-workers.

Column 3 in the table gives the $\sin^2\theta$ values corresponding to various bands and lines. Column 4 gives the plane indexes based on a cubic or pseudo-cubic structure taking the lattice spacing as 8·18 A. The assignment of these indices is perhaps more apparent than real. It does not mean necessarily that our results are in favour of the crystallite theory of glasses, as no crystalline modification of SiO_2 can fall into this scheme. Moreover, the occurrence of the bands and their relative intensities vary with the specimen and with different circumstances. We are not of the opinion that the sharp lines are due to devitrification if the word 'devitrification' has its usual significance, since it is extremely unlikely that when glass is devitrified the diffraction from the crystallites should have but a few sharp lines while the others remain diffuse.


a *b* *c*

The difference shown by the Debye-Scherrer photographs and the pin-hole transmission photographs may be interpreted on the ground that on powdering a glass a certain freedom of re-arrangement is regained[5], thus causing certain changes in the structure. This point has been verified by taking a pin-hole transmission photograph of a slab of powder. The photograph comes out to be the same as that taken with the Debye-Scherrer camera, as shown in photograph *c*.

We have noticed that in the transmission photographs the relative intensities of the two bands *O* and *B* may change even with different locations of the same specimen. This appears to support Prins's idea that the degree of organization of glasses may be appreciably different in neighbouring small regions[6]. In other words, large fluctuations do occur in vitreous silica.

Fourier integral analysis is now being used to investigate from our own photographs the possible radial distribution of the scattering centres.

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[4] Hartleif, G., *Z. anorg. u. allg. Chem.*, **238**, 353 (1938).

[5] See Bernal's discussion on glass, *Trans. Faraday Soc.*, **33**, 113 (1937).

[6] Prins, J. A., *Trans. Faraday Soc.*, **33**, 110 (1937).

Band Spectrum of Sodium Hydride

The band spectrum of sodium hydride has been studied by Hori[1,2] and later by Olsson[3]. Olsson concluded from his analysis of the spectrum of NaD that the values of v' given by Hori[2] for NaH should be raised by three units. The results given below were obtained with the view of supplying the missing data for the three lowest vibrational levels of the excited state, which are of especial interest for comparison with the corresponding data for the hydrides of the other alkali metals.

The spectrum was obtained from a discharge tube of the type described by Pearse and Gaydon[4], and grating photographs were taken (dispersions 2·6 and 1·9 A./mm.) in the region λλ 6400–4900. The results of the analysis of the spectrum are summarized below.

Origins of new bands :

(v',v'')	ν	λ	(v',v'')	ν	λ
(2,3)	19659·8	5085·1	(1,6)	16375·6	6105·0
(3,3)	19996·9	4999·4	(2,6)	16705·6	5984·4
			(4,6)	17386·6	5750·0
(2,4)	18638·6	5363·7	(5,6)	17736·2	5636·6
(3,4)	18975·8	5268·4			
(4,4)	19319·5	5174·7			
(5,4)	19669·5	5082·6	(3,7)	16130·0	6197·9
(6,4)	20023·2	4992·8	(4,7)	16473·7	6068·6
(7,4)	20380·4	4905·3	(5,7)	16823·4	5942·5
			(7,7)	17534·6	5701·4
(1,5)	17324·3	5770·6			
(2,5)	17654·3	5662·8			
(3,5)	17991·5	5556·6	(5,8)	15946 4	6269·3
(5,5)	18685·0	5350·4	(6,8)	16300 5	6133·1
(6,5)	19038·8	5251·0	(7,8)	16657·7	6001·6
(7,5)	19396·0	5154·3			

$$\nu = 22719{\cdot}1 + (310{\cdot}6u' + 5{\cdot}41u'^2 - 0{\cdot}197u'^3 - 0{\cdot}00073u'^4 + 0{\cdot}000073u'^5) - (1172{\cdot}2u'' - 19{\cdot}72u''^2 + 0{\cdot}160u''^3 - 0{\cdot}005u''^4),$$

where $u = v + \frac{1}{2}$.

Rotational constants for the lower levels of the excited state :

v'	1	2	3
B'	1·823	1·875	1·908
$-D' \times 10^4$	2·25	2·25	2·20
$F' \times 10^8$	5·1	3·9	3·0

Rotational constants for the ground-leve :

$$B'' = 4{\cdot}886 - 0{\cdot}129u''$$
$$-D'' \times 10^4 = 2{\cdot}76 + 0{\cdot}20u'' - 0{\cdot}021u''^2$$
$$F'' \times 10^8 = 1{\cdot}7$$

It is hoped to publish the analysis soon in greater detail ; further work is also in hand.

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[1] Hori, T., *Z. Phys.*, **62**, 352 (1930).

[2] Hori, T., *Z. Phys.*, **71**, 478 (1931).

[3] Olsson, E., *Z. Phys.*, **93**, 206 (1935).

[4] Pearse, R. W. B., and Gaydon, A. G., *Proc. Phys. Soc.*, **50**, 201 (1938).

RESEARCH ITEMS

Rancidity of Pork and its Prevention

When pork is stored in the frozen condition for subsequent manufacture into 'Wiltshire' bacon, changes are apt to occur in the fat which may become rancid, and in the lean which may lose colour and become dry on the surface. By studying pork kept for forty-eight weeks in various conditions of humidity and temperature, W. H. Cook and W. Harold White have found that temperature is the primary factor concerned (*Canadian J. Res.*, **19**, Sect. D, 53; 1941). The temperatures tested ranged from −6·6° to −23° C. A significant increase in peroxide oxygen occurred in fat with any increase in temperature over −12·2° C., and it was considered that temperature and not the presence of moulds was the prime factor responsible for rancidity. Even at the relatively high temperature of −6·6° C. the content of free fatty acid was small and could contribute little to the deterioration of pork fat. If rancidity is to be prevented over storage periods of approximately one year's duration, storage temperatures of −18° C. or lower are essential. If drying of the surface and the associated discoloration is to be avoided, a temperature of −18° C. must also be maintained, but samples which suffered the greatest colour change during storage showed the least change during subsequent exposure.

Red Sea Corals

C. Crossland deals in a report issued by the Egyptian Biological Station at Ghardaqa with the coral formations, fringing reefs and barriers extending off the shores of the Red Sea for more than 1,500 miles. The coastal areas are also formed from reef structures of recent age; they are about 1 km. wide and seldom more than 20 ft. thick. The fringing reefs are erosion platforms cut into the last with very little addition by recent growth. Outside are irregular areas extending in front of the shore formations; they are often separated by water of much greater depth than in any coral lagoon and thus differ from the regular barrier reefs. Lithothamnioneæ are not constituents of importance, and hence these reefs have no raised edges. Submerged shoals were extensively explored by means of the grab, which gives the most accurate quantitative results. They are mostly flat with edges steep. While all of suitable depth are covered with coral material, this is usually dead. Few living corals were obtained and these of small size, though surface reefs luxuriant in coral life are found in their vicinity. The tables of some proved distinctly deeper than they were when originally charted. Besides these, the echo sounder showed numerous submarine hills still farther seaward. Some of these reach the surface and form shoals or islets rising in water several hundred fathoms deep. Their coral caps do not provide debris to cover more than the first 40 fathoms of their slopes; the Red Sea region does not possess extensive talus slopes round its reefs. Indeed the whole conditions lead Dr. Crossland to think that, on balance, both reef formation and coral growth is now in decline in the Red Sea—a condition also postulated for some coral regions of the Indian Ocean.

Fossil Lizards from Utah

In 1937 a Smithsonian expedition was fortunate to discover a locality in Utah in which the Saurian remains were not only the most ancient known from North America but were the best preserved and articulated yet found on that continent. A preliminary account, by Charles W. Gilmore, of a new genus and species, *Polyglyphanodon sternbergi*, describes a dentition unique among Saurians. The teeth are subacrodont and heterodont, the posterior ones being much widened with sharp transverse cutting ridges. Upper and lower teeth are indistinguishable; there are 6 in the premaxillary, 18 in maxillary and 19 in dentary (*Smithsonian Misc. Colls.*, **99**, No. 16).

Neuroptera of the Nearctic Region

F. M. Carpenter, of Harvard University, has published a revisional memoir on the Hemerobioid division of the Neuroptera (*Proc. Amer. Acad. Arts and Sci.*, **74**, 193; 1940). It is based on the examination of more than eight thousand specimens a considerable number of which were from European museums. The terminology employed is, in the main, that of Killington (1936), but it is noteworthy that the interpretation of the wing venation is based on the findings of the Russian entomologist, Martynov (1928), who showed that the anterior branch of the media has become partially amalgamated with the radius. This conclusion has been confirmed by the late R. J. Tillyard, and also by the author of the present paper. What appears to be the last branch of the radial sector in these insects is, in reality, the anterior media which was previously supposed to be wanting in Neuroptera. One of the most interesting of the lace-wings recorded is the holarctic species, *Psectra diptera*. Rare in Britain, and in no case abundant in other lands, its nearctic range is the north-east part of America. From an examination of forty-four examples the author concludes that the dimorphism shown in this species is not a peculiarity of sex, since both dipterous males and females are recorded in equal numbers. Of considerable interest is the family Polystoechotidæ, which is confined to the New World, and hitherto represented by a single genus. The discovery of a second and new genus, Platystoechotes, from California, is based on a single species named *P. lineatus*.

Alternation of Generations in Perennating Rust Fungi

An interesting account of the alternation of the rust fungus from the binucleate to the uni-nucleate mycelium types, in the case when the rust fungus remains a permanent infection on a perennating host, has recently been published by A. M. Brown (*Canad. J. Res.*, **19**, 75; 1941). Rust-free plants of *Lactuca pulchella* may be infected with *Puccinia minussensis* by inoculating the seedling leaves or the rhizome buds of older plants, with either the æcidiospores or uredospores, or by packing teleutospores into the leaf axil of mature plants and afterwards using the infected nodes as parts of propagation cuttings. However the plant is infected the binucleate mycelium of the parasite makes its way along the shoot and into the rhizomes, but before it reaches the terminal buds of the rhizomes its nuclear condition changes, as only the uninucleate mycelium has been found in the bud scales. Such infected rhizome buds give shoots on which pycnidia alone are seen at first. Thus the alternation from the binucleate to the uninucleate condition depends apparently on the maturity of the host tissue involved and the food supply available to the fungus.

Sugar-Cane Field Experiments

SOME fourteen years ago, the Sugar Cane Investigation Committee of Trinidad embarked on its work with a single manurial experiment on the land of one of the larger companies. The passage of time has witnessed a notable expansion of the original research programme, present-day work being concerned not only with the influence of fertilizers and mixtures of fertilizers on yield, but taking in its stride the effect of such operations as drainage and cultural practices and the response of varieties to different soil types. Since 1936 the number of experiments has remained stationary at an average of sixty-five a year. Some idea of the extent of the work now on hand may perhaps be given by referring to the report for 1940 just received (Ann. Rept., 1940, Sugar Cane Invest. Committee, Trinidad, by P. E. Turner). This report, which is by way of being a straightforward, brief record of many individual experiments, runs to some two hundred and sixty pages and refers to the results obtained, on a variety of soil types, from applications of ground limestone, sulphate of ammonia, potash and phosphate, in various mixtures, and from such by-products as pen-manure, molasses and filter-press mud; while cultural processes included drainage, furrowing, mulching with megasse, and different spacings of plants. Varietal tests alone involved records on nine different soil types. Layouts enabling orthodox use of the analysis of variance have been used throughout. Because of the nature of the work, no attempt can be made here to indicate, even in the most abbreviated form, the many useful and economically important results which have accrued. The scheme, in fact, has justified itself in a most reassuring fashion, and shows in a striking way the service which the modern soil chemist and agronomist can render, even within the brief span of a few years, to agriculture, provided the experimental programme is supported by adequate funds and afforded reasonable facilities.

Sex Chromosomes of Apodemus

P. C. KOLLER (*J. Gen.*, 41, 375–390; 1941) has examined the sex chromosomes of *Apodemus sylvaticus*, the field mouse, and *A. hebridensis*, the local Hebridean race. He shows that these sex-chromosomes have similar general properties to those found in the sex-chromosomes of many other organisms. There is a pairing segment in the X and Y chromosomes and a differential segment in the Y chromosome. In *A. sylvaticus*, the centromere is medianly placed in the pairing segment which may form chiasmata on either side of the centromere. 92 per cent of the spermatocytes show post reduction. *A. hebridensis* has a smaller Y chromosome than *A. sylvaticus* and the fact that post-reduction is obligatory indicates that the distal part of the pairing segment is too small to form a chiasma. The difference between the sex-chromosomes of the two species could be brought about by a change in the position of the centromere through a pericentric inversion. Thus the distal portion of the pairing segment would be greatly reduced and therefore be unable to form a chiasma.

Chromatid Interference

C. L. Huskins and H. B. Newcombe (*Genetics*, 26, 101–128; 1941) have investigated the chromosome configurations of *Trillium erectum* involving pairs of chiasmata. By an analysis of the possible appearances of the chromatids they are able to show that, in 240 bivalents, compensating chiasmata are greatly in excess of non-compensating chiasmata. Hence one chiasma partially determines the chromatids involved in the second chiasma. The simplest types of chromatid arrangement are more prevalent in shorter lengths and also in cells with higher chiasma frequency. Therefore, the distance between adjacent chiasmata has a great effect on the type of chromatid arrangement. Re-examination of genetical data in Drosophila indicates that there may be a similar length-type relationship—short distances are associated with an excess of two-strand double cross-overs (compensating types).

Formation of Martensite on Wire Ropes

WIRE ropes used in mining, and particularly haulage ropes, are subject in service to severe wear which, by reducing the cross-sectional area of the outer wires, gradually reduces the strength of the ropes. A more serious cause of deterioration, difficult to detect and therefore correspondingly dangerous, results from the formation of a brittle surface on the outer wires which leads to their rapid failure by the development of cracks beginning in the brittle layer. In one case where failure occurred microscopic examination of the wires showed the presence of a layer of martensite covering a large area of the worn surface, but having a maximum thickness of only 0·003 in. In a paper discussed before the Iron and Steel Institute (May, 1941), E. M. Trent describes the occurrence of such thin layers of martensite on the worn surfaces of wire ropes. Similar martensitic surfaces have been reproduced in the laboratory by a number of methods, such as striking the wire a glancing blow with a hardened steel tool or rubbing the wire with a steel tool under heavy pressure. The metallurgical structures of the layers are described, and their effect on the mechanical properties of the wire is discussed. It is concluded that the formation of martensite is an important cause of deterioration and failure in haulage ropes, and it is pointed out that care should be taken to prevent such ropes from rubbing against metal objects such as seized pulleys or rollers, rails, steel sleepers, roof girders, etc. Under certain conditions of corrosion the presence of martensite containing cracks leads to the formation of corrosion pits on the worn surfaces of wires. When these pits take the form of what is known as 'chain pitting', they indicate that martensite is probably present.

A Plutonic Phase in Seismic Prospecting

THE phase pP has been well recorded from plutonic or deep-focus, earthquakes. An interesting occurrence, of this same phase has been observed by L. D. Leet (Paper 29, Geophysical Research, Harvard University) in certain seismic prospecting operations.

Velocity calibrations are occasionally obtained by lowering a seismometer into a well and timing the travel to it of waves from explosions near the surface. In the occurrence reported by Leet, records were taken in a well at depths from 2,000 ft. to 5,790 ft. Shots were fired at the bottom of a 46-ft. hole, and a second seismometer was placed on the surface near this shot hole to record the up-hole time of the first wave in the ground. In earthquake terminology, this supplied waves of which the focal depth, travel time to the epicentre, and travel time to a distant station were accurately known. The up-hole time averaged close to 0·015 sec. and the $pP-P$ interval very nearly the 0·03 sec. to be expected under those conditions. At 4,000 ft. and 4,500 ft., according to Leet, pP is actually larger in amplitude than P. It is always well marked, and appears to begin 180° out of phase with P. The abnormal number of crests shown by many reflected groups in routine prospecting is undoubtedly traceable, in part at least, to this dual nature of the incident energy. With shot holes of this or greater depth, there is even danger that pP will be mistaken for a reflexion from a horizon deeper than that which actually returned it to the surface.

Protein Structure

THE cyclol hypothesis of protein structure is considered by D. M. Wrinch (*J. Amer. Chem. Soc.*, **63**, 330; 1941) in relation to arguments against it which have been advanced by Pauling and Niemann (*J. Amer. Chem. Soc.*, **61**, 1860; 1939). It is pointed out that the arguments against the theory based on interatomic distances are not binding, since examples are known in other fields where the chemical evidence is not compatible with these distances. The heat of denaturation which has been put forward as evidence against the theory is shown to depend on bond energies which, it is claimed, are used in a way on which little reliance can be placed. The argument based on the assumption that Anson and Mirsky's denatured trypsin consists of linear polypeptides is claimed to be invalid, as the cyclol theory does not assume the opening of all cyclol bonds, but only that any breakdown of the intact structure is produced by the opening of any subset of cyclol bonds, and it offers an interpretation of the fact that very different denatured products can be obtained from one and the same protein.

Resolving Agent for Carbonyl Compounds

COMPARATIVELY few resolutions of racemic carbonyl compounds are described in the literature. Of several optically active hydrazine derivatives which might be used as resolving agents, many have not been obtained pure and the majority are oils or solids of low melting point. None of them yields readily crystalline derivatives with a variety of carbonyl compounds. R. B. Woodward, T. P. Kohman and G. C. Harris (*J. Amer. Chem. Soc.*, **63**, 120; 1941) have found that *l*-menthol may be readily converted into *l*-menthyl-N-aminocarbamate by the action of ethyl chloroformate in presence of pyridine and treatment of the resulting ethyl *l*-menthyl carbonate with hydrazine. The aminocarbamate (which is called *l*-menthydrazide) is a stable, beautifully crystalline substance which with numerous carbonyl compounds gives stable crystalline derivatives of sharp melting points and definite specific rotations. The use of the reagent was demonstrated by the first successful resolution of *dl*-camphor.

Catalytic Activity and Structure of Metal Films

FROM the laboratories of the Shell Development Company, Emeryville, California, comes a study of the correlation of catalytic activity and physical structure of the catalyst. In the experiments carried out by O. Beeck, A. E. Smith and A. Wheeler (*Proc. Roy. Soc.*, A, **117**, 63; 1940) metal films of high and reproducible catalytic activity were got by condensation on to glass at suitable temperatures. Low-pressure adsorption of hydrogen at room temperature and of carbon monoxide at liquid air temperature showed that oriented gas-evaporated nickel films have twice the available surface per gram of randomly oriented high-vacuum films, but ten times the activity. The oriented films have therefore five times the activity of unoriented films. The activity per unit weight of the films was constant, indicating that the reaction gases easily reached the interior. Adsorption of hydrogen was too fast to be measured. Adsorption isotherms on nickel film were got for ethylene, carbon monoxide, nitrogen, hydrogen and oxygen. The poisoning effect of carbon monoxide and oxygen and the effect of sintering were studied. Most of the work was done with nickel films, but films of iron, cobalt, palladium, platinum and copper were also used. The enhanced activity of oriented films appears to be associated with the larger distances in the (110) plane of nickel or the (111) plane of iron. The bearing of the results on the definition of active centres and on the general problem of adsorption is discussed.

Soft X-Ray Spectroscopy of Solids

AN account is given by H. W. B. Skinner (*Phil. Trans. Roy. Soc.*, A, **239**; 1940) of an experimental study carried out in the H. H. Wills Physical Laboratory of the University of Bristol of the *K*- and *L*-emission spectra from elements of the first two groups of the periodic classification. A characteristic difference between the bands of metals and non-metals was found. The temperature effect on the metal bands is directly connected with the Maxwellian distribution of the conduction electrons and the influence of thermal expansion is appreciable. A large broadening of the valence levels of lowest energy is proposed. In determining the precise features of a band, the crystal structure of the material is the most important factor.

Water on Mars

IT is now seven years since observations of the *B* band in the spectrum of Mars established that the amount of free oxygen in the atmosphere of the planet was negligibly small. Spectrograms taken more recently with a 9-ft. spectrograph at the coudé focus of the 100-in. reflector at Mount Wilson have now been examined (*Astrophys. J.*, **93**, 16; 1941) in order to detect, if possible, water-vapour lines due to absorption in the Martian atmosphere. The region photographed includes two prominent groups of water-vapour lines near 7000 A. Four plates were secured when Mars was approaching the earth, and three when it was receding. Any Martian contribution to the water-vapour lines should thus cause the measured wave-lengths to differ in the two sets of plates. No significant difference is found, however, and the sensitivity of the method enables an upper limit for the amount of water-vapour in the equatorial regions of Mars to be fixed at 5 per cent of that in the earth's atmosphere. These Mount Wilson researches are making the surface of Mars seem less and less inviting for life as we know it on the earth.

AGRICULTURAL LAND AND NATIONAL PLANNING*

By Dr. L. Dudley Stamp

In his speech to Parliament on February 26, Lord Reith made a statement on the duties assigned to him as Minister of Works and Buildings which were summarized as "seeing that all practicable preparations are made for the physical reconstruction of town and country". It was stated that the preparatory work would proceed on certain assumptions including :

"That the principle of planning will be accepted as national policy and that some central planning authority will be required.

"That this Authority will proceed on a positive policy for such matters as agriculture, industrial development and transport."

Lord Reith went on to direct attention to the huge acreage of good agricultural land which has been lost by unplanned development of industry or housing, and it is now clear that planners recognize the necessity and are willing to endorse the fundamental principle of the reservation of the best agricultural land[1]. This is a change of heart compared with the past twenty years, when there has been a clash of interests and a struggle for the same types of land which has fallen with especial severity on the best agricultural land. Level or gently undulating, well-drained land has not only those qualities which go to the making of the finest market gardening tracts but also those suitable for rapid development of housing, for the horizontal layout of modern factories, for aerodromes, playing-fields and even for great reservoirs. When such land is needed for 'development' its development value so far exceeds its value as agricultural land that every time agricultural interests tend to be ignored. National planning will not necessarily provide a remedy, since some of the worst offenders in promoting misuse of good land have been town planners and the powerful corporations behind them.

If the fair apportionment of our national resources of land between the various uses and users is accepted as a primary object of national planning, the reservation of the best agricultural land becomes a matter of immediate and urgent importance and cannot be carried out without the classification of land and the mapping of the categories distinguished.

A preliminary scheme of classification and a tentative small-scale map of England and Wales were prepared at the request of the Royal Commission on the Geographical Location of the Industrial Population by the Land Utilisation Survey[2]. With the co-operation of experts in the varied fields concerned, it has now been possible to elaborate the scheme of classification and to combine the results of county maps prepared by local workers into a general map of England and Wales on the scale of 10 miles to one inch. From this map the approximate acreages and percentages given below have been calculated. The data used are being recorded in the County Reports of the Survey, published under the title of the "Land of Britain".

The classification proposed is a simple tenfold one, based essentially on the broad physical features of the land—quality and depth of soil, elevation, exposure, situation, climatic factors—which remain dominant considerations despite technical progress in the treatment of land by manuring, drainage, etc. Treatment can up-grade land and render it more productive, but does not alter its fundamental character.

Prefixes : *A*—dominantly arable ; *G*—dominantly grassland ; *H*—dominantly heathland, moorland or rough pasture.

A 1. *First-Class Arable Land*, capable of intensive cultivation. Level or gently undulating. Deep, fertile, easily worked loam and silt soils, retentive of moisture and of fertilizers and often naturally rich in humus and mineral salts. 1,785,000 acres or 4·8 per cent of England and Wales.

A 2. *Good Arable Land*, suitable for crop production. Found especially in eastern England where a rainfall of less than 30 inches, and good sunshine, as well as soil and relief favour arable farming and the ripening of corn crops. 5,642,000 acres or 15·0 per cent.

AG 2. *Good General-purpose Farm Land.* Found especially in the west of England where by reason of heavier rainfall it is suitable for ley farming—good grass and a limited range of crops. 1,446,000 acres or 3·8 per cent.

G 3. *First Quality Grassland*, fatting pastures and good dairy pastures. Neutral grassland dominated by rye grass (*Lolium perenne*) and wild white clover (*Trifolium repens*). Mowing meadows yield 1–2 tons of hay per acre, pastures fatten animals without subsidiary feeding. Though not necessarily of lower fertility, much of this land is unsuitable for arable cultivation owing to high water table, periodic flooding or heavy soil. 758,000 acres or 2·0 per cent.

G 4. *Good Grassland.* Neutral grassland with Agrostis and meadow grasses, usually on heavy clay soils which, though fertile, are difficult and expensive to plough. With surface water and small field units, more suitable for grassland farming. 2,875,500 acres or 7·7 per cent.

Mixed *A* 2 and *G* 4 land occupies a further 2,613,000 acres or 7·0 per cent and other areas where the better types of farming land are intimately intermingled cover together another 1,460,000 acres or 3·9 per cent. This gives a total of 16,579,500 acres or 44·2 per cent of England and Wales for the better farm lands.

AG 5. *Downland and Basic (Limestone) Grassland.* Soils usually thin, light and calcareous ; where ploughable (*A* 5) typical arable-sheep-barley land ; where in grass or unploughable (as on Limestone Pennines, *G* 5) traditional fescue sheep-pastures. *A* 5 also includes certain other light-soiled arable tracts. 1,333,500 acres or 3·6 per cent. In addition, there are 1,262,000 acres or 3·4 per cent with an admixture of better land.

AG 6. *Medium Quality Farmland.* Land productive both under crops and grass but which, by reason of slope, climate or soil, can never become first class. Soils generally immature and stony. Includes much of the farm land on the older rocks of western Britain, worked on a system of long leys. Grassland generally acidic or siliceous, dominated by

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* Summary of a paper read before the Town and Country Planning Conference held at Oxford, March 28-31, 1941.

Agrostis or Agrostis-Festuca, liable to invasion by bracken, gorse, etc., and much in need of liming, manuring, draining or re-seeding. 8,281,000 acres or 22·1 per cent, in addition to which there are 2,010,000 acres or 5·3 per cent with an admixture of better land.

G 7. *Poor Quality Heavy Land.* Land with very heavy, intractable soils or low-lying and difficult to drain. Poor grassland, especially Agrostis infested by rushes (Juncus). 382,500 acres or 1·0 per cent, together with 988,000 acres (2·6 per cent) of which parts have already been improved. This does not, of course, include the huge areas of *AG* 6 and *G* 4 land badly in need of better drainage—probably half of the whole. Medium quality farm land (categories 5, 6 and 7) thus totals 14,257,000 acres or 38·0 per cent of England and Wales.

H 8. *Poor Quality Mountain Land* (Mountain or Rough Hill Pastures). Natural and semi-natural vegetation covering much of the uplands of old rocks especially above 1,000 feet. Thin, poor, stony, immature soils, usually leached and podsolic ; in areas of impeded drainage, acid peats ; in some areas many rock outcrops. Vegetation permits a detailed classification (leading types are Nardus–Molinia moors, Eriophorum moors, heather moors, bilberry moors, etc.) and gives a clue to possibilities of improvement and use. 3,735,000 acres or 9·9 per cent, together with an additional 723,500 acres or 1·9 per cent with improved patches.

H 9. *Poor Quality Light Land* (Lowland Heaths and Moors). Very light sandy or gravelly podsolized soils usually too 'hungry' (that is, unretentive of manures) for economic cultivation. Usually heathland ; suitable for coniferous afforestation or use as open spaces. Includes also some undrained fens and mosses. 316,000 acres or 0·8 per cent, in addition to 1,200,000 or 3·2 per cent mixed with better land.

H 10. *Poorest Land* (Saltings, Rough Marsh Pasture, Shingle, etc.). Land of varied character, but in its present state of little agricultural value, though some (salt marshes) could be reclaimed. 78,000 acres or 0·2 per cent.

As matters of national policy it is suggested : (*a*) that the first four categories, that is, the best agricultural lands, be preserved so far as possible in agricultural use ; (*b*) that major schemes using large areas of land—for green belts, national parks, afforestation, etc.—be restricted to the poorer types of land. Other developments such as new trunk roads of the parkway type can well be aligned accordingly, while some of the poorest land (for example, salt marshes) is well situated for heavy industry ; (*c*) that the integration of land use envisaged by town planning schemes, the establishment of garden cities, etc., is especially important on land of intermediate quality.

The above figures are provisional estimates and include the Isle of Man. Closely built-over areas such as the centres of cities and industrial works are excluded but land already occupied by houses with gardens is included. Calculations of the areas of the latter are being made and the map referred to is now in the Press.

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[1] See, for example, *Town and Country Planning*, March 1941, where this principle is stressed by the writers of four articles out of five published in that issue.

[2] Summarized in NATURE, 143, 456 (1939).

STRUCTURE OF MOLECULES AND AGGREGATES OF MOLECULES

A SYMPOSIUM on the structure of molecules and aggregates of molecules was held at Columbia University during December 30–January 1, 1941, under the auspices of the Division of Physical and Inorganic Chemistry of the American Chemical Society. Some twenty papers which were submitted at this meeting appear *in extenso* in the January numbers of the *Journal of Chemical Physics* and the *Journal of the American Chemical Society.*

In a short introductory paper, Prof. J. G. Kirkwood, chairman of the organizing committee, points out that "modern physical chemistry is primarily concerned with problems of structure as related both to the properties of systems in equilibrium and to the mechanism of the physical and chemical processes traversed in the attainment of equilibrium". A large variety of theoretical and experimental techniques are, therefore, required to enable the determination of the structure of molecules of vastly different complexities, the structure of molecular aggregates, the nature and magnitude of intermolecular forces, the spatial arrangement of atoms in a molecule or of molecules in an aggregate, interatomic distances, and many other properties. On the theoretical side quantum mechanics lead to a fuller understanding of individual molecules, and aggregates of molecules are being investigated to a very great extent by the methods of statistical mechanics. On the experimental side the structure of simple molecules can be elucidated by a variety of well-established methods ; but to investigate the structure of solid and liquid aggregates is more difficult and, of the available methods, X-ray methods appear to give the fullest information. Thermodynamic properties also shed light on structural theories of gases, but with liquids and solids the evidence from this source is less complete and less conclusive ; nevertheless, increasingly promising results on these latter types are accruing from their statistical mechanical treatment.

The papers, presented at the symposium and briefly summarized here, illustrate the width and variety of the topic and the modern means of tackling its immense unsolved mysteries.

Among the purely theoretical contributions is one by Mayer and Montroll, who have put forward definitions of functions capable of describing the distribution of molecules in a system and have derived equations for their evaluation. When applied to gases, the distribution functions can be developed in power series in fugacity or inverse volume in which the coefficients are integrals involving the mutual potential energy between pairs of molecules. Extension to condensed systems, although possible, renders the equations much more complicated, but their approximate solution can be achieved by application of the cell method involving the probabilities of population of virtual cells.

Quite a different application of statistical mechanics is made by J. C. Slater in attempting to explain the transition in KH_2PO_4. The crystal structure indicates that the PO_4 groups are connected by hydrogen bonds, and thus different orientations of the H_2PO_4' dipoles will arise from different possible arrangements of the hydrogens. When the H_2PO_4' groups are pointing along the axis of the crystal they will have lowest energy, and spontaneous polarization along his axis will occur causing polarization below the Curie point. The statistical mechanical treatment predicts for this transition a phase change of the first order with a sudden change from the low-temperature polarized state to the high-temperature unpolarized state. Experimentally it has been found that the transition is of the second order and is confined to a much narrower temperature range than that predicted by the Weiss theory. But this may be due to broadening of a first-order phase change rising from irregular shifts of transition temperatures in certain regions of the crystal produced by stresses and deformation at temperatures below the transition point. It has been found, too, that the susceptibility above the Curie point, calculated by the statistical mechanical method, agrees, unlike the predicted value on the Weiss theory, with the experimental result. On the other hand, the calculated entropy change is unaccountably 0·11 units less than the observed value.

The existing qualitative ideas regarding hyperconjugation, that is, the conjugation of a group such as CH_3 with groups containing double or triple bonds, are put on a quantitative basis by a quantum-mechanical treatment by R. S. Mulliken *et al.** Hyperconjugation is considered to be omnipresent. Three general types of conjugation are recognized: (*a*) first order conjugation, for example, $HC{\equiv}C{-}C{\equiv}CH$; (*b*) second order conjugation (first order hyperconjugation), for example, $H_3{\equiv}C{-}C{\equiv}H$; (*c*) third order conjugation (second order hyperconjugation), for example, $H_3{\equiv}C{-}C{\equiv}H_3$. Hyperconjugation stabilizes molecules. Bonds are of two types, donor or acceptor; C–H bonds in saturated hydrocarbons are donor and C–C bonds acceptor. As a result of type (*c*) conjugation acceptor bonds gain appreciably in stability whereas donor bonds lose only a small amount of stability. Hyperconjugation confers on C–C bonds approximately 11 per cent double bond character and on C=C bonds about 12 per cent triple bond character. The effects of conjugation in various molecules receive detailed discussion.

Debye, in 1925, explained the salting out of non-electrolytes by their electrostatic interaction with ions, and treated the non-electrolyte as a homogeneous medium. This method is extended and applied to the whole range of composition of alcohol-water mixtures by Scatchard, who takes account of the heterogeneity of the solvent. Satisfactory agreement with experimental data was not obtained probably because account was not taken of the actual structure of the solvent.

The ascertainment of structure is possible by a variety of methods, and the symposium contains several papers on experimental and theoretical aspects of this topic. Beach, in continuation of his electron diffraction studies, contributes a paper dealing with the structure and dimensions of dioxadiene, *p*-dioxene, and furan and two of its derivatives. In electron diffraction work information about the intensity distribution of scattered electrons is at present not very readily obtained. Recent improvements in technique, for example, the introduction of the rotating sector, should soon yield experimental information on this point. It should then be possible not only to determine interatomic distances but also to ascertain their natural degree of indeterminacy. The problem is treated theoretically by Debye by considering the influences of atomic vibrations and of free and hindered rotation of molecular groups on the scattering properties.

The application of X-ray spectroscopy is made by Hoard and Martin* to the structure of oxyfluoniobates. Interaction between aqueous solutions of niobium pentafluoride, NbF_5, and potassium fluoride, KF, gives either $K_2NbOF_5H_2O$ or K_3NbOF_6; and, if HF is added as a third reactant, K_3HNbOF_7 or K_2NbF_7. These are all crystalline compounds and their preparation, crystal forms, and the structures of the different ions are discussed, particularly K_3HNbO_7 which is found to be an aggregate of $K^{\cdot}$, HF', and octahedral $NbOF_5''$ ions, having the salt-like structure $K_2NbOF_5.KHF_2$ and isomorphous with $K_2SnF_6.KHF_2$ and $K_2PbF_6.KHF_2$. On the theoretical side Huggins extends Bragg's photographic method for making a Fourier summation from crystal diffraction data.

Analysis of vibrational spectra of polyatomic molecules is difficult but there are several aids available. An important one is the evaluation of force constants by means of normal co-ordinate calculations. Using a valency-force potential these force constants may be employed to study the character of different bonds and their variation with environment. Crawford and Brinkley examine this problem with reference to the six related molecules HCN, C_2H_2, C_2H_6, CH_3CN, methyl- and dimethyl-acetylene, and they show that stretching constants vary with bond type and with bond length, whereas bending and interaction constants vary only with bond type. To reduce the work of calculating vibration frequencies of complex molecules, Wilson develops various schemes and applies them to the methyl chloride molecule. He derives from these developments a modification of the Teller-Redlich isotopic product theorem. Morse functions, usually calculated from the energy of dissociation, nuclear separation, and fundamental vibration frequency, have been calculated by Hulbert and Hirschfelder, taking into account the additional spectroscopic constants, $\omega_e x_e$ and α_e, and the method is applied to twenty-five diatomic molecules belonging to various classes, for example, hydrogen molecules, hydrides, halogens, oxides, alkalis. The new five-parameter curves give potentials which lie above the Morse curves and indicate that the corrections for moderately large internuclear distances may amount to 10 per cent of the energy of dissociation. Where comparison is possible there is good agreement between observed and calculated potentials.

Smyth* discusses induction, resonance, and dipole moments and assesses contributions to dipole moments from inductive effects and resonance structures for a variety of molecules. He also computes the amount of ionic character in various bonds and obtains values in good agreement with electronegativities derived from thermal data. Comparison of the amounts of double bond character in carbon-halogen bonds in monohalogenobenzenes calculated from dipole moment data with those calculated from interatomic distances reveals wide differences and leads to the conclusion that the amounts of resonance contributions to dipole moment values cannot be accurately ascertained. The significance of this conclusion may be somewhat altered by the revised values of the covalent radii of H, O, N, and F given by Schomaker and Stevenson* who also show that the bond length between two atoms A and B, $\hat{r}_{AB}$ is less than the sum of the normal single covalent bond radii, $r_A + r_B$, by 0·09 times the difference between the electronegativities of A and B.

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* Papers published in *Journal of the American Chemical Society.*

Groups surrounding a chromophoric group exercise profound influences on the group and may even induce electronic transitions resulting in optical activity. These "vicinal actions" are discussed by Eyring and Kauzmann by reference to a large variety of substances, and they show that optical rotatory power may be utilized in investigating the structure of molecules, provided that due account is taken of "vicinal actions" in calculating optical rotations.

Van Vleck obtains expressions for the susceptibility of an antiferromagnetic medium by means of the Debye vector model and finds tolerable agreement with experimental data. O. K. Rice discusses the equation of state for argon and derives its potential energy curve. The uncertainty as to whether it is the total potential of the electrode or only the overvoltage that is involved in the discharge of gaseous ions has been resolved by Kimball *et al.*, who postulate the existence of two different electrical double layers at the electrode surface and two corresponding energy barriers over which protons must pass. What these barriers correspond with cannot be unequivocally established, but it appears that most probably both correspond to proton transfers from water molecule to water molecule.

Rabinowitch and Epstein* discuss the polymerization of dyestuffs in solution from absorption spectra measurements on thionene and methylene blue. Organic dyestuffs show a universal property of dimerization quantitatively interpretable by London's theory of intermolecular forces. The physical chemistry of insulin is investigated by Cohn *et al.* using the radioactive isotope of zinc (Zn*) and studying the influences of excess Zn*, *p*H and ionic strength on the crystallization and solubility of insulin.

The simultaneous appearance of these papers will prove of immense value to all interested in modern physical chemistry. The topic has so many varied aspects that it calls for large numbers of investigators, each a specialist in his own field. Co-ordination of the contributions of the various specialists is necessary to enable the 'ordinary' physical chemist to appreciate to the full the significance of the various contributions. It therefore seems a pity that the whole symposium was not published in *one* journal and that the discussions on the papers were not published along with them.

CARNEGIE INSTITUTION OF WASHINGTON

YEAR BOOK No. 39 of the Carnegie Institution at Washington covers the year July 1, 1939–June 30, 1940. In addition to the report of the President, it includes reports on the departmental activities and co-operative studies covering astronomy, terrestrial sciences, biological sciences and historical research.

The President, in his report, refers to the intensification of scientific activities in the United States even in fields which are remote from the National Defence Programme. This he attributes to the stimulation of a democracy by the existence of danger, and suggests that fundamental scientific advance, like basic intellectual accomplishment of many kinds, is often accelerated rather than retarded by national stress. The income from endowment continued to decrease, but the current situation was transformed during the year by an emergency grant of 750,000 dollars from the Carnegie Corporation of New York, payable at the rate of 150,000 dollars annually for five years, and the year closed with a substantial excess of income over estimate.

The Geophysical Laboratory and the Department of Terrestrial Magnetism have co-operated during the year in a programme which substantially extends the limits of experimental work on the properties of materials under enormous pressures, utilizing a cascaded pressure equipment with which pressures of 200,000 atmospheres have already been reached, and certain physical measurements can be conducted with material under this pressure. High-temperature studies of anhydrous systems and their presentation by equilibrium diagrams have been continued in the Geophysical Laboratory, as well as studies of equilibrium in systems containing water at various pressures and temperatures. The Department of Terrestrial Magnetism has also continued its studies on the ionosphere as well as its geomagnetic studies on fluctuations in solar radiation, while its activities in nuclear physics have been extended to include a programme of fundamental work in biology and chemistry utilizing the artificial radioactive isotopes of ordinary elements as tracers for following various reactions. This programme centres round a large cyclotron installed last year. Observations at the Mount Wilson Observatory have afforded definite evidence of the presence of organic compounds in interstellar space, and the evidence for the hydrocarbon gas CH and for cyanogen CN′ is almost conclusive. The Department of Genetics has investigated the mechanism by which cosmic rays as well as X-rays cause mutations and hence the appearance of individuals differing abruptly from their ancestors. It has been found that very considerable delay may occur between the fracture of a chromosome and its rearrangement so that reproduction may proceed. Experimental modification of the process, for example, by the use of alkaloids to cause the doubling of chromosomes, yielded much new knowledge. The report includes a review of this work, as well as an account of endocrine studies in the same Department. Biochemical investigations in the Division of Plant Biology have covered the organic nutrition of plants, the use of radioactive carbon dioxide in photosynthesis, and oxidation, reduction and reactions in killed leaves. The report also includes an account of work by Robert Emerson and C. M. Lewis on the quantum efficiency of photosynthesis and the absorption of carbon dioxide in the light and in the dark. Work by the Department of Embryology has covered the physiology of the reproductive system, the endocrine organs, tissue culture and tumour studies, as well as investigations on the nervous system. The report also includes a brief account of investigations in the Nutrition Laboratory and by the Division of Historical Research.

THE NATIONAL CENTRAL LIBRARY

THE twenty-fourth annual report of the Executive Committee of the National Central Library covers the year 1939–40 and indicates the important contribution the Library is making to the nation's war effort. It is a centre which is used by Government Departments, research stations and industrial concerns and a channel through which books immediately essential for war purposes are being regularly supplied. At the same time it is ensuring that essential information is regularly available for those engaged in agriculture, trade and business of all descriptions. Among special war work now being done by the Library mention may be made of assistance given by lending books to the camp libraries which are being established in connexion with the Lord Mayor of London's Services' Libraries and Book Fund by supplying bibliographical information to the Prisoners of War Book Service and by assisting the Sea War Library Service which supplies books to men serving in the Royal Navy and Mercantile Marine.

In July 1939 the Treasury announced that its grant to the Library for the year 1939–40 was to be reduced from £5,000 to £4,800, but a special grant of £100 has been provided by both the Governors of the Thomas Wall Trust and the Trustees of the Cassel Educational Trust to meet this deficit. The Treasury has since announced, in December 1939, that the grant-in-aid for the year 1940–41 is to be limited to £3,500, but this deficit has been met by an emergency grant from the Rockefeller Foundation of 8,500 dollars for the year 1940–41. The number of volumes in the Library was increased during the year from 161,383 to 170,972 and the total number of books issued during the year was 50,611, including 1,191 books issued to adult classes. After the first few weeks of the War there was a steady increase in the number of applications received as well as in the percentage of important books asked for and the requests for bibliographical information. The group of Outlier Libraries now includes 114 special libraries, 2 urban libraries which are not yet co-operating in a regional system and 19 London borough libraries. During the year the Bibliographical Society and the British Social Hygiene Council were added to these special libraries. A total of 491 libraries is now co-operating in the regional system and there are only 24 urban libraries serving a population of more than 20,000 which are not co-operating in this system.

The number of books issued to university libraries, excluding those issued to adult classes, decreased to 3,046 during the year, and 4,440 books were lent by the university libraries to other libraries through the national system. Books borrowed from libraries in other countries for the use of libraries in the British Isles decreased to 159 compared with 283 in the previous year.

Owing to the risk of destruction of property in the centre of London all the Union Catalogues as well as all other irreplaceable or scarce bibliographical material were moved early in September 1939 to Bourne Lodge, Bourne End, Hemel Hempstead, the non-bibliographical books and books belonging to the adult class department being left at Malet Place. This was among the buildings in London recently destroyed by enemy action, and although a large number of books have been saved, many thousands have been destroyed, including the whole of the books in the adult class department and many long and valuable sets of publications. This loss is serious not only to the National Central Library itself but also to all other libraries in the British Isles which depend upon it for the books they are unable to supply from their own shelves.

The Library is still able to give its unique service in arranging loans of books between libraries, the total number of volumes upon which it is able to draw for this purpose being no fewer than 21,000,000. The Trustees have already made arrangements to continue the full work of the Library and it is hoped that funds may be forthcoming to enable them to replace the more urgently wanted books.

NATURAL GAS IN ONTARIO

IN view of the present more or less acute natural gas situation, J. F. Caley has anticipated a comprehensive memoir (now in the Press) by a brief mimeographed report on natural gas in Brantford Area, Ontario*. The report has actually been condensed from the more detailed work and is intended to be an up-to-date guide to operators and others interested in the particular area.

The region known as Brantford area extends for approximately 4,800 square miles from Dundas in the east to Aylmer in the west, and from Mount Forest in the north to the shore of Lake Erie in the south. Commercial production of natural gas is obtained from that part of the area lying south of an east–west line drawn through Paris and comes entirely from rocks of Silurian age, namely, the Medina, Clinton and Guelph formations. Actual productive horizons involved are the fine- to medium-grained sandstones of the Whirlpool (White Medina); light grey and red sandstone and sandy shale of the Grimsby (Red Medina); grey and buff crystalline or granular limestone of the Clinton; and the grey, buff or cream-coloured, crystalline and finely granular dolomite found in the upper part of the Guelph formation.

A map showing structure contours drawn on top of the Clinton and accompanying the report shows that regional structure is monoclinal and has a southerly dip averaging approximately 24 ft. a mile over the whole producing area. Such variations in rate and direction of dip as occur have been caused by unequal settling of the beds and variations in thickness of groups of beds; they are not attributable to folding of the strata. Moreover, there is no apparent relation between structure and presence or absence of producing horizons. Accumulations of natural gas appear to be due to the porous character of certain beds and the existence of small decreases in dip within circumscribed areas.

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* Canada Department of Mines and Resources. Mines and Geology Branch, Geological Survey Paper 40–42. Preliminary Report: Natural Gas in Brantford Area, Ontario. J. F. Caley. Pp. ii+31+1 map. (Ottawa: King's Printer, 1940.)

There is no evidence to indicate that features favourable to the accumulation of natural gas are confined to those parts of the southern area already in production, neither has sufficient exploratory work been carried out to define by dry holes limits of fields now in operation. It would appear, therefore, that investigations could usefully be carried out both in the northern part of Brantford area where the Guelph and Trenton formations in certain districts offer prospects of production, and also in the several untested, or apparently untested, parts intervening between existing wells in the southern part of the area.

STORAGE OF AUSTRALIAN APPLES

THE Jonathan apple is the chief variety exported from Victoria, between 600,000 and 700,000 bushels being sent overseas annually. Large quantities are also kept in cool storage for local consumption. Two or three pickings are made at fortnightly intervals, the earlier fruits, which are usually green, immature and acidic being exported. The large portion of the crop is picked in a late stage of maturity and considerable wastage occurs due to physiological breakdowns and moulds. With the object of reducing this wastage, Trout, Tindale and Huelin (*Bull.* No. 135, Australian Coun. Sci. and Ind. Res., 1940) have carried out an intensive study of the effect of different factors on keeping quality. The most important are maturity at the time of picking, seasonal and growing conditions, size of the fruit and crop, conditions immediately after picking, and conditions during storage. The ground colour of the fruit is a good index of the stage of maturity in a given district. Immature fruit is not very susceptible to storage disorders, but soft scald and breakdown are more frequent the longer the fruit is left on the tree. 'Jonathan Spot' develops in both immature and over-mature fruit. Soft scald is greatest between June and July and at 32° F. It can be controlled by storage at 36°–37° F. The most mature fruit is most susceptible to breakdown, which is greatest at 32° F.

Mould and Jonathan Spot are greater at higher storage temperatures. Susceptibility to soft scald is increased by short periods at 55° F. and 65° F., before transfer to storage at 32° F., but decreases with longer periods. Cooling to 36°–45° F. immediately after picking is recommended, though the available cool storage space is at present a problem. Storage life can be prolonged by using an atmosphere containing 5 per cent carbon dioxide and 16 per cent oxygen at 36° F. Brownheart occurs with greater concentrations of carbon dioxide. Short treatment with 36 per cent carbon dioxide reduces subsequent soft scald at 32° F. but increases breakdown and Jonathan Spot. The ratio of cane sugar to acid in the fruit is correlated with keeping quality and with the ground colour at picking time.

FORTHCOMING EVENTS

[*Meetings marked with an asterisk are open to the public.*]

Monday, May 26

ROYAL GEOGRAPHICAL SOCIETY (at the Cinema Theatre of the Imperial Institute, South Kensington, London, S.W.7), at 5 p.m.—Colour and Sound Films of India by the Lawrence Thaw Expedition, and of Burma by Mr. Nathan.

Tuesday, May 27

ROYAL INSTITUTION OF GREAT BRITAIN (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. C. F. A. Pantin, F.R.S.: "The Origin of Life".*

Wednesday, May 28

INSTITUTE OF METALS (at the New Clarendon Laboratory, Oxford), at 3.30 p.m.—Dr. F. Simon, F.R.S.: "The Significance of Low Temperature Research" (Thirty-first Annual May Lecture).

Thursday, May 29

ROYAL INSTITUTION OF GREAT BRITAIN (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Mr. W. H. Ansell: "The Re-Planning of London".*

Friday, May 30

PHYSICAL SOCIETY (at the Lecture Theatre of the Science Museum, Exhibition Road, London, S.W.7), at 5 p.m.—Dr. H. Spencer Jones, F.R.S.: "The 200-inch Telescope" (Twelfth Thomas Young Oration).*

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SENIOR LECTURER IN ENGINEERING in the Oxford Schools of Technology, Art and Commerce—The Chief Education Officer, City Education Office, 77 George Street, Oxford (June 3).

BOROUGH ELECTRICAL ENGINEER—The Town Clerk, Guildhall, Maidenhead (endorsed 'Borough Electrical Engineer') (June 5).

ENGINEER for the Government of Sierra Leone Public Works Department—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9552).

LECTURER IN BIOLOGY WITH SOME HYGIENE—The Principal, Training College, Hereford.

LECTURER IN ELECTRICAL ENGINEERING in the Norwich College—The Director of Education, City Hall, Norwich.

SECRETARY—The Director of Research, British Launderers' Research Association, The Laboratories, Hill View Gardens, Hendon, London, N.W.4.

MAINTENANCE ENGINEER for the Transport and Harbours Department of the British Guiana Government—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9393).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 11: On a World Correlation of the Pleistocene. By T. T. Paterson Pp. 373–425. (Edinburgh and London: Oliver and Boyd.) 6*s.* 6*d.* [15

Quarterly Journal of the Royal Meteorological Society. Vol. 67, No. 289: The Phenological Report, 1940. Pp. 67–98. (London: Royal Meteorological Society.) 3*s.* [55

London Shellac Research Bureau. Technical Paper No. 20: Plasticising Lac Films, Part 2. By G. D. Heath and Dr. B. S. Gidvani. Pp. 14+2 plates. (London: London Shellac Research Bureau.) [55

Other Countries

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 46: A Brief Survey of some of the Important Breeds of Cattle in India, Part 3: Prize Winners at the Second and Third All-India Cattle Shows. Pp. iii+30+34 plates. (Delhi: Manager of Publications.) 2 rupees; 3*s.* [55

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Geology and Topography: Geological Survey. Memoir 224: Palæozoic Geology of the Toronto-Hamilton Area, Ontario. By J. F. Caley. (No. 2456.) Pp. iv+284. 75 cents. Memoir 225: The Picton Coalfield, Nova Scotia. By W. A. Bell. (No. 2457.) Pp. v+142+10 plates. 50 cents. (Ottawa: King's Printer.) [75

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RECONSTRUCTION AND PLANNING

A NOTEWORTHY illustration of the strength of the national morale is the widespread interest taken in post-War reconstruction. The immediate task of the Ministry of Works and Buildings in speeding up the erection of buildings needed for the war effort is generally taken for granted. It is the contribution of the Ministry to the building of the world we shall live in after the War that captures the popular imagination.

It is somewhat surprising, therefore, that so little attention has been given in the Press to the Conference on National Planning held by the Garden Cities and Town Planning Association at Oxford on March 28–30. However much it may be necessary to postpone the physical reconstruction until after the War, it is essential that the principles upon which our policy is to be based and by which action is to be guided should be elucidated and defined as early as possible, even if only in view of their bearing on the wise direction of our war effort—as, indeed, the Select Committee on National Expenditure has hinted. A summary account of some of the papers appears on p. 684 of this issue of NATURE.

Research is equally important on particular questions and on those involving general policy and principles. This point was well made by Major E. Maxwell Fry in a recent address to the Housing Centre on "Research on a Plan for London". A town-planning scheme must be the result of research into the elements of living, which must be organized in the most efficient manner. The problem in London is concentrated in the provision of good housing, opportunities for adequate leisure and healthy work-places, linked together by efficient transport services. These four elements—work, leisure, housing and transport—are interdependent and form the basis of the problem.

Investigation on the general and on the particular questions must clearly proceed simultaneously if we are to be prepared when the full opportunities arise after the War. Moreover, there are matters in which action may be required during the War to prevent the growth of further obstacles to central development and effective local planning. To some of these attention was directed by Sir Ernest Simon in a paper before the Conference on National Planning on urban land-ownership and management after the War, and Lord Samuel, in a reference to the same subject, welcomed a statement in the House of Lords by Lord Brocket, chairman of the Land Union, that the Union is ready to welcome reasonably devised measures for bringing the use of the land into conformity with the interests of the nation. To problems such as compensation and betterment the Uthwatt Committee is already giving attention, and it may well be hoped that Lord Reith will take action in time to prevent private interests in the devastated districts or elsewhere creating obstacles to developments required in the public interest.

The further attention directed to these matters by the Conference on National Planning is warmly to be welcomed, and the fresh support forthcoming for national planning should at least lead to fuller consideration of the recommendations of the Royal Commission on the Location of Industry.

There are undoubtedly limitations on the extent to which effort can be expended in these directions during war-time. It is all the more important, therefore, that the more restricted opportunities should not be missed. The discussions at Oxford are supplemented by Mr. Ritchie Calder in his Democratic Order Pamphlet No. 5, the theme of which is that we should start planning Britain now. The essential thing is that, as Mr. W. H. Ansell, president of the Royal Institute of British Architects, urged in his paper on "The London of the Future" before the Royal Society of Arts on March 12, we should clarify our general principles and think about those principles before proceeding to particular planning. Too often in the past the thinking has followed the planning, or rather the lack of planning. The immediate urgency is the preparation of the plan in order that when peace comes upon us, it shall not find us unready, and in consequence rebuilding of our cities and factories take undesirable forms.

Mr. Ansell's paper alone is an inspiring picture of possibilities in the planning and rebuilding of London—the redistribution of industries, the re-planning of traffic, of docks and markets, the restoration to the City of something of the glory lost by its congestion, the preservation and encouragement of community areas or the creation of new ones, the re-planning of commercial areas and the architectural opportunities in scientific and fire-resisting reconstruction—possibilities which in varying degrees are inherent in the planning and reconstruction anywhere necessitated by devastation through bombing. The vision of possibilities, when fortified by the determination to use our opportunities, can supply steadiness in the dark days of ordeal which may yet lie ahead, and the stimulus to co-operation in the work of reconstruction, with something of the national unity and energy at present displayed in our war effort.

Several aspects of planning are referred to in two Democratic Order series of pamphlets referred to below*. Mr. Calder ranges concisely over the whole field, indicating mistakes and confusion in the past, the present position, not merely of the Ministry of Works and Buildings, but also of planning and location of industry as resulting from the Barlow Commission inquiry, the weakness of local and regional authorities, and the opportunities and problems which have already been thrown up by the War. With many of these scientific workers are familiar, but Mr. Calder surveys them with a lucidity which should bring home to every citizen the vital need for some definite policy and national planning.

Mr. Calder shows, too, how this question of planning and reconstruction is linked up with the development of social services, particularly with questions of nutrition and medical service, and the tremendous demands it makes on the intelligent use of our resources on scientific lines, whether in such matters as standardization, transport, or the interlocking of agricultural and other industries, food policy and nutrition, and the effect of changes in the age structure of our population upon housing and educational needs and policy. National planning is, in fact, more than the peace aim on which Mr. Calder insists. It is a vital part of our war effort and one of the ways in which we can, as Mr. Francis Williams argues, in "What are we waiting for ?", make democracy not only something to fight for but something to fight with. A determined effort to deal now with the question of planning and all that is involved in working out the lines of policy, not just for physical reconstruction but also for the social and economic reconstruction needed, would give us a most effective weapon for the overthrow of the slavery masquerading throughout the greater part of Europe as the Nazi "New Order".

There are indeed welcome signs that this is increasingly recognized by the Government itself. The whole tenor of Lord Reith's recent statement in the House of Lords was coloured by the assumption that the principle of planning would be accepted as national policy, and that a central planning authority would be established. He has shown himself, further, to possess large and comprehensive views and to be alive to the need for further investigation. The examination of conditions in Birmingham, Coventry and Bristol and the whole-hearted support given to the work of the National Buildings Record are sufficient example. The personnel of the Consultative Panel on Reconstruction already announced by Lord Reith has commanded widespread approval ; indeed, the chief concern at the present moment is that whatever plans are finally accepted should be consistent with the principles that administrative control should not be divided and that the planning authority should have power to put its policy into effect.

This is the main argument of two admirable articles which have recently appeared, one entitled "Problems of Reconstruction. I. Building", in the *Round Table* of March, and the other by Mr. Thomas Sharp on "Planning for Reconstruction" in the *Political Quarterly* of April–June. Both point to the dangers inherent in the large number of Government departments concerned and the imperative need for co-ordination and for the handling of the main groups of problems by specially constituted ministries or sub-ministries, untrammelled by departmentalism. Lord Reith's own Ministry of Works and Buildings is the only example so far of the kind of special department required, and whether or not the present Ministry is expanded into a Ministry of Planning and takes over other functions from the Ministry of Health, War-time Communications, Agriculture, the Central Electricity Board, the Forestry Commissioners, the "National Industrial Board" recommended by the Barlow Commission and the National Park Commission recommended by the National Parks Committee, if the present opportunity is to be used some authority must be given power to plan all post-war land now, and to initiate the bold measures which will make possible the successful execution of a post-war building programme embodying the new approach to social problems involved in the planning of a new and better society.

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* The Democratic Order. No. 1: What are we waiting for ?: a Call to Britain. By Francis Williams. Pp. 64. No. 5: Start Planning Britain Now: a Policy for Reconstruction. By Ritchie Calder. Pp. 64. (London : Kegan Paul and Co., Ltd., 1941.). 1s. net each.

A scheme suggested in the *Round Table* visualizes the Ministry of Works and Buildings as supreme authority and including four distinct sections. The first of these is the lineal descendant, much expanded, of His Majesty's Office of Works, which, among other functions, might exercise the required control over building and stimulate the far-sighted statesmanship on the side of employers and trade unions required in planning boldly several years ahead. The second is a long-term planning organization concerned with the location of industry and with town and country planning, exercising many of the functions recommended in the Minority Report of the Barlow Commission, including the functions and powers transferred from the Ministry of Health, the former Ministry of Transport and the Commissioners for the Special Areas. This division would co-ordinate the long-term building projects so that too much is not attempted in any one year, but the detailed planning and execution of the building programme of the whole country, both civil and Governmental, would be entrusted to a programme department. Both these departments would work in close contact with a National Investment Board and the National Housing Board.

Besides these three divisions, a housing division is suggested which would take over most of the present housing functions of the Ministry of Health and supervise housing finance through the National Housing Board. The latter would be a purely financial institution, the nucleus of which might well be formed by the building societies; but by accepting responsibilities of landlordship, it would be able to compel builders to accept high standards of design and workmanship. The division would supervise the quality of the houses built and enter into direct relations with the local authorities in respect of the programmes carried out by them.

A centralized plan of this character does not mean the imposition of local building programmes from above. Only national requirements should be planned at the centre. Regional and local details within the national plan should be planned regionally through a series of regional planning commissions, but some one department must deal with all land-using activities if the waste of land and its misdirection from the purpose which best serves the public interest, whether by the speculative builder, the industrialist or the Forestry Commissioners, is to be stopped. Administrative power in a democracy must remain in close contact with the people, their welfare and their desires.

These thoughtful articles are no less insistent than Mr. Francis Williams, in his lively and provocative "What are we waiting for ?", that the start on such planning must be made now, and that we must not allow the attempt to be hampered by the professional tradition or outlook of the Civil Service. Nor need we despair, even with the present demand for man-power, of allocating a proportion to prepare us to meet post-War problems. Obviously some thought is already being given to these matters by the Government. Regional geographers, sociologists, economists, architects and town-planners may be reasonably expected to pay attention to these problems even in war-time.

There should indeed be no insuperable obstacles to the marshalling at the present moment of an effective proportion of the trained intelligence of the nation to the formulation of policy and plans to prevent hindrances to reconstruction developing during the War, as well as scramble, confusion and improvised plans and decisions to meet demands for action which will urgently and insistently arise when the War ends. Only by foresight, coupled with constructive imagination, clear thinking and unflinching loyalty to sound administrative principles throughout the present days of war, can we ensure an adequate recompense after the War for all the sufferings and hardship we have already faced or may still be called upon to endure.

RELATION OF CRIME TO NATION AND RACE

Crime and the Man

By Earnest Albert Hooton. Pp. xvi+403. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 21*s.* 6*d.* net.

The American Criminal

An Anthropological Study. By Earnest Albert Hooton, with the collaboration of the Statistical Laboratory of the Division of Anthropology, Harvard University. Vol. 1: The Native White Criminal of Native Parentage. Pp. xvi+309+482+15. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1939.) 56*s.* net.

IN 1938, when Prof. E. A. Hooton had completed a survey of the bodily features of American criminals and compared them with observations made on corresponding samples of 'unconvicted' civilians, he was invited by the Lowell Institute to give lectures on the harvest he had reaped. These lectures have been published as a book under the title "Crime and the Man"; they give a clear and almost joyous account of a survey of the prison population of ten States, which occupied more than twelve years, included upwards of 17,000 individuals and involved the tabulation and statistical treatment of about 2½ millions of measurements and observations. The criminals and their civil 'control' samples fall into four groups: (1) native whites born of parents who were also born in the United States; (2) native whites born of immigrant parents; (3) white immigrants; (4) citizens of African—or mainly African—origin. Each of these groups is to receive full descriptive and statistical treatment in a separate publication issued by the Harvard University Press under the title "The American Criminal: An Anthropological Study", of which the first volume has now been published. It contains 309 pages of text and 482 pages of tables; vol. 2 will deal with groups 2 and 3; while vol. 3 will deal with the African group.

Prof. Hooton speaks of the publication of this great three-volumed work as "a manifestation of an incredibly non-commercial policy", while the publisher, with equal modesty, claims that "so far as known it is the most extensive anthropological study of criminals ever made". As to preceding works of this nature—why! there is only "The English Convict", published in 1913 by Dr. Charles Goring, in comparison a minor work, of which, by the way, Prof. Hooton, in his outspoken way, passes both praise and blame. I am more sanguine than either author or publisher as to the merits and future of this work. Apart from giving proof that there is a correlation between type of criminal and type of crime, and between race and crime, as well as between nationality and crime, Prof. Hooton deals in its pages with principles which lie at the foundation of anthropological investigation of the living and has opened up important side-lines of inquiry and so produced a work which should be in the library of every anthropologist.

First, let me mention briefly some of the more important of the "side-lines". Prof. Hooton was surprised to find, after he had assembled his data, that each State had its own prevailing anthropological types. There is thus already at work in the United States a tendency to produce local breeds of humanity, due, as Prof. Hooton suspects, to the isolation and inbreeding of the original settlers of the various areas. Students of human evolution, who regard isolation and inbreeding as the main conditions necessary for the development of separate breeds and races of mankind, herein receive encouragement.

Another of the side-line inquiries relates to the process of 'Americanization', namely, that children of immigrants, born in the United States, undergo not only a cultural but also a transformation of body in the land of adoption. There are many, besides the reviewer, who viewed with scepticism the claims made by Prof. Franz Boas that children born to Italian parents in America differ in head form, and in many other statistical details, from the original Italian stock. Scepticism is no longer possible, for Prof. Hooton's statistical inquiries confirm those of Prof. Boas. Of the various nationalities, the Italians undergo the greatest degree of physical Americanization. With such inquiries it is pertinent to compare those made by Dr. H. L. Shapiro[1] on Japanese born in Hawaii. This observer found that the Hawaiian Japanese differed statistically from the immigrant Japanese and these, in turn, differed from the folk in Japan from which they had been drawn. How we are to explain such environmental transformations I do not know, but it is plain that all three of Dr. Shapiro's groups remained unmistakably Japanese.

When he sought to trace the relationship of race to crime, Prof. Hooton had to assign 5,689 white American criminals to one or other of the racial stocks of Europe. He found only 106 that could be classified as purely Nordic in characterization, 145 pure Alpine and 252 pure Mediterranean. Thus only 9 per cent of the total number of criminals were assignable to the three racial divisions into which the majority of anthropologists separate Europeans. Even if we add a fourth division, namely, the Polish or East Baltic, which Prof. Hooton regards as a pure race, there still remained 88 per cent of the prison polulation of America which were unassignable to pure breeds and had therefore had to be placed in mongrel categories. Herein we see a justification for those who maintain that the only living races in Europe are such as are demarcated by national frontiers.

To repel such a suggestion Prof. Hooton might well cite the fact that he has proved that there is a closer relationship between his racial types—nine in number—and a tendency to crime, than there is between national groups and their predisposition to crime. Further, he has found that the kinds of crime to which his small and pure racial groups are prone are more sharply characterized in body than is the case in the larger mongrel groups. Thus the evidence justifies Prof. Hooton's contention that there is a relationship between a criminal's conformation of body and his tendency to commit criminal or anti-social acts. We note, too, that he expects to find a relationship of racial type to social behaviour.

Coming now to the main theme of Prof. Hooton's survey we note that he emphatically rejects the existence of a single representative type of criminal man. He finds that each form of crime—of which he recognizes ten kinds or groups—draws preponderatingly from a civilian group which possesses certain physical characters, as well as social qualities, so that each kind of crime has its own physical type of criminal.

This review has touched only on the fringe of the harvest reaped by Prof. Hooton during the twelve years he spent in a statistical purgatory. His observations on the physique of the insane, on the Negro—in jail and out of jail—his zeal for reform in the treatment of criminals, his forays into eugenics, his attacks on the wrong gods of democracies—all of these have to be passed by with a mere mention. But enough has been said of these two books to tempt anthropologists to study them and, I have no doubt, to profit from them.

A. KEITH.

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[1] "Migration and Environment", 1939. Reviewed by Prof. Wood-Jones. NATURE, July 29, 1939, p. 177.

PRESENT-DAY AERIAL WARFARE

(1) Defence Against the Night Bomber

By Noel Pemberton-Billing. Pp. 191. (London: Robert Hale, Ltd., n.d.) 2*s.* 6*d.* net.

(2) The Military Aeroplane

By E. Colston Shepherd. (Oxford Pamphlets on World Affairs, No. 44.) Pp. 32. (Oxford: Clarendon Press; London: Oxford University Press, 1941.) 4*d.* net.

(1) THE reviewer, when reading this book, was reminded of one of his old professors who was always insistent upon his students never becoming too fantastic in their scientific ideas. He used to say that if he was asked to build a bridge across the Straits of Dover, for the benefit of travellers prone to sea-sickness, as an engineer with a knowledge of the theory of structures he would reply that it was not "impossible", but as a man of the world he would say that it was entirely "impracticable". To use the term "impracticable" is not an unfair criticism of the author's ideas for dealing with night bombers. Remembering his many-sided experience, including some in practical aeronautics, one wonders just how much of this book was written with his tongue in his cheek. For example, his suggestion for covering the country with a mantle of light which would not only blind the raiders but reveal them to the night fighters above them, is logical, and sounds fascinating. But where is all the apparatus, the men to manipulate it, the electrical power, or even the coal to produce it, coming from? It is already obvious to even a lay observer that man-power in the factories is going to be one of the decisive factors in this War.

His prospect of towed fighters sounds good until one asks where all the fuel is to be found, and how collisions are to be avoided. To be effective, a constant patrol over the whole of the country, relatively closely spaced, would have to be maintained. Would not the same amount of fuel consumed, and labour necessary to build and maintain such a fleet, be better expended in preventing the enemy from building bombers by flying over and blowing up his works?

Incidentally, one does not have to understand the technicalities of aeronautics to appreciate the fact that as the R.A.F. so thoroughly smashed the daylight attacks upon Great Britain, the principal problem remaining is to give a night fighter apparatus with which he can detect an enemy machine in the dark. He has already shown himself capable of doing the rest. Upon this problem the book is discreetly silent.

Stimulating reading, as any contact with Mr. Pemberton-Billing always is, but a serious contribution to the scientific aspect of the problem of night defence, No!

(2) This book, No. 44 of the Oxford Pamphlets on World Affairs, is the second written by Mr. E. Colston Shepherd upon matters aeronautical. The other, No. 28, was entitled "Britain's Air Power". These pamphlets are intended to be short, concise explanations of affairs that are necessarily the province of the specialist, written in such a manner that they appeal to the ordinary reader. This volume certainly maintains the high standard of these publications and is well worth reading by those not familiar with the war developments in aviation. It is written in a restrained style, unclouded by the author's personal opinion too often, and presents the situation to-day, written by one who obviously knows much more than he thinks it politic to say in print.

The author explains the meaning and duties of the different types of war machines: the fighter, long-distance fighter, bomber, precision bomber, dive bomber, torpedo carrier, reconnaissance aircraft and army co-operation machine. He then discusses their possible developments and their limitations from the points of view of both their design and use. He finishes with a general discussion upon probable future developments, a dangerous procedure at any time, and particularly so when those developments take place under the stress of war-time demands. At least one of his prophecies has come true since it was written: "The Tornado fighter with its new Vulture Engine should have a speed of more than 400 m.p.h." His whole summing up is exemplified in one of his sentences, with which we must all agree, "Both sides are striving above all for more speed", and if he had added greater range or armament carrying capacity, he would have stated the case even more completely.

THE ULTRA-PERCEPTIVE FACULTY

Exploring the Ultra-Perceptive Faculty
By Dr. J. Hettinger. Pp. 172. (London: Rider and Co., 1941.) 12*s*. 6*d*. net.

IN this book Dr. Hettinger, whose previous work on the so-called ultra-perceptive faculty has already been noticed in NATURE (Feb. 22, p. 217), gives an account of further experiments in the same field, which he has devised partly in order to satisfy the need for a method of inquiry which, he thinks, may enable the faculty to be demonstrated at will.

For this purpose a person is first asked to set his watch at a time prearranged with another person or 'sensitive', who may be at any distance from him—in this case several miles. He is then asked to look slowly for about one hour at some illustrated periodical, reading any short articles that may be of interest and glancing at the illustrations, while noting down the times at which the various items were seen. At the other end the 'sensitive', in company with the experimenter, makes a series of statements which come into consciousness, the only link with the subject at a distance being some object or other belonging to the subject, this article being placed within reach or under the hands of the 'sensitive'. The experimenter then notes what is said by the 'sensitive', jotting down the times of the various statements at intervals of about one minute to correspond with the intervals noted by the subject when reading the periodical.

It is claimed that when the statements made by the 'sensitive' are compared with, for example, the illustrations seen by the subject, close approximation, both in time and subject-matter, is often established in a number of instances. Thus when the subject was looking at a photograph of a large horse, the 'sensitive' was saying, "Some admiration for large cart horses"; and when the subject had a picture of a camera before him the 'sensitive' was saying, "A large camera and bright light". In both these cases and in many others no time lag is claimed, the times being almost, if not quite exact.

Although at first sight the results of these experiments may appear both striking and impressive, it would seem that Dr. Hettinger might have done better to delay publication until he had attempted a much closer and more detailed analysis of his results. In this report he has not printed a single one of the full statements of a 'sensitive' in any one case, a record clearly desirable if the value of the items given is to be properly appraised. Moreover, Dr. Hettinger seems to have been somewhat too complacent when dealing with some of his results which, he thinks, can be accepted without applicable statistical checks and corroborative testimony by independent witnesses. How far he is right in this surmise remains to be seen. Suffice it to say that these findings are certainly of some interest; but it would seem that much work remains to be done and many control experiments devised, before it can be stated with any degree of confidence that here again we have solid evidence that some form of ultra-perceptive faculty has been fully established.

E. J. DINGWALL.

The Anodic Oxidation of Aluminium and its Alloys

By Dr. A. Jenny. Translated by Winifred Lewis. (Griffin's Technological Handbooks.) Pp. vii + 231. (London: Charles Griffin and Co., Ltd., 1940.) 16*s*. net.

THE protection of aluminium and its alloys by anodic oxidation is so important a process that it now constitutes an industry of itself, requiring a specialized literature. This is the first text-book to be produced for the anodic oxidation specialist, and its design to satisfy his needs results in what might at first appear to be a peculiar mixture of chemical, electrical and electro-chemical theory. It is divided into two main parts, the first being devoted to basic electro-chemistry, the chemical properties of aluminium and its alloys, the valve effect at aluminium anodes, and the anodic oxidation process. The second part deals with more practical aspects, such as operating details, the properties and applications of the films produced by different techniques, sealing and dyeing of the films, and chemical protective processes. Brief particulars are also given of the reflector processes and the "Seo" photo process.

One or two criticisms of detail may be made; aluminium does *not* form a useful protective film in chloride solutions (p. 63) and may be very seriously attacked by anhydrous stearic acid in the absence of air (p. 64); and many readers in Great Britain will be disappointed by the limited attention given to the Bengough–Stewart process. Nevertheless, the book must be recommended to all interested in the protection of aluminium alloys.

H. W. G. H.

Wayside and Woodland Trees

A Guide to the British Sylva. By Edward Step. Revised by A. Keith Jackson and A. Bruce Jackson. Pp. xxxviii + 186 + 175 plates. (London and New York: Frederick Warne and Co., Ltd., 1940.) 9*s*. 6*d*. net.

A NEW edition of this well-known work is very welcome, especially in view of the fact that it has been revised by A. K. Jackson of Kew Herbarium and A. B. Jackson of the British Museum (Natural History). Yet we do not like either of the two most outstanding features—the colour photography is attractive but misleading; and what a pity Mr. Henry Irving's superb photographs of trees in winter and summer are not placed on opposite pages. Since they are printed on art paper and inserted, this might have been difficult though not impossible. The authors' claim that this means of making a striking comparison is "rather novel" is not true. It has been done before, but nevertheless it is a great asset to any book on trees.

All trees indigenous to Great Britain are portrayed and described; so also are some exotics which have become established in these Islands. There are two pictorial keys—one based on leaf character in summer, the other on bud character in winter. These, together with the beautiful photographs and the clear and accurate line diagrams and descriptions will make it almost impossible to come across a tree and fail to identify it.

Surface Tension and the Spreading of Liquids

By Dr. R. S. Burdon. (Cambridge Physical Tracts.) Pp. xiii + 85. (Cambridge: At the University Press, 1940.) 7*s*. 6*d*. net.

DR. BURDON'S short treatise can be heartily recommended as a clear, and very concise, account of most of the principal phenomena involving liquids and their interfaces with gases and solids. The methods of measuring surface tension, and the details of spreading of liquids on liquids (including spreading on mercury, to which the author has made notable contributions) are treated in considerable detail; contact angles, with several of their important technical applications, are also described in detail; there are short but sound and clear sections on the relation between intermolecular forces and capillary phenomena, and on monolayers on water. Lubrication and adsorption are also touched upon. The treatment is non-mathematical, only a few formulæ being given.

The book is up to date, and, though brief, manages to convey a surprising amount of information in small compass, references to larger treatises and to original papers being given where necessary. The author usually gives the substance of accepted theory, without, however, sacrificing a pleasing directness and originality of treatment. The book differs from some of the Cambridge physical tracts in being less an account of specialized work in a restricted field than a short introduction to a wide group of subjects, but it should prove very useful.

N. K. A.

Animals in Action

By Dr. Gayle Pickwell. (Whittlesey House Publication.) Pp. xii + 190. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 24*s*.

THIS new book by Prof. Pickwell is similar in format to his three previous publications which, chiefly owing to their superb illustrations, have become well known among naturalists in Great Britain. Again, therefore, must we welcome an admirably produced work, with a stimulating text and sixty-eight arresting plates, most of them single photographs, $9\frac{1}{2}$ in. × $7\frac{1}{2}$ in.

The whole of the animal kingdom is covered, and the subject-matter is considered under the following main headings: general review; animals at home; animals as parents; animals growing up; animals getting food; animal protection; animals getting air; animals getting about; animal kinds; how to know animals.

The author is professor of zoology in the San José State College; but this book makes it clear that he is not only a teacher but also a lover of animals and a master of the technique of photography. The book would certainly broaden the vision of students of zoology or biology (usually so tied down to the examination 'type' system), and it would be treasured by any professional or lay natural historian. Thus it would make a suitable prize or present which could scarcely be surpassed by anything produced on similar lines in Great Britain.

SOYA BEAN CULTURE IN GREAT BRITAIN

By Dr. H. H. Mann,
Woburn Experimental Station, Bletchley

IS it possible to grow soya beans successfully, on a commercial scale, in Great Britain? There is no doubt that if this culture could be established, a most valuable addition to our agricultural resources would be made, for the soya bean is one of the most valuable of the world's oil seeds, besides being capable of many other uses. Yet, except for a relatively small area in Canada, none of it is produced within the British Commonwealth.

At its maximum, the world's production of the bean was estimated at fifteen million tons[1]. The largest grower is China, though in that country almost the whole of the output is consumed as human food. It is Manchuria whose production dominates the world's oil seed market, and there the area in 1937 was nearly nine million acres. In recent years, the United States has entered the front rank of soya bean producers, and now, apart from the very large area on which the crop is simply cultivated for its fodder value, between two and three million acres are grown for seed purposes and a substantial export trade has been built up. Its cultivation as a source of oil has also extended very largely into the Balkan countries, chiefly into Rumania and Bulgaria, where the area before the War was not far from three hundred thousand acres, and into the U.S.S.R., where at its maximum (1931) the crop covered more than a million acres, though this has since been very much reduced[2].

With such large developments of a crop which had formerly been almost a monopoly of northern China and Manchuria, it was natural that interest in its possibilities in Great Britain should have arisen, and for a good many years rather casual experiments in its culture have been undertaken. The chances of success appeared to be considerable. In comparison with most other oil seeds, it has the advantage that it grows commercially under much more temperate conditions than other sources of vegetable oil, and, further, the seeds are a source of a very tasty human food (being, in fact, originally imported as a condiment), while the oil cake forms a rich animal feeding stuff as well as a good fertilizer. The dearth of home-produced oil seeds at the present time would make, in fact, any considerable extension of the crop a matter of national importance.

All early experiments, however, indicated that most of the available types of soya beans would be of no use for seed production in Great Britain[3]. If planted early in the spring, they were ruined by late frosts. They usually ripened so late in the autumn that the seed often went mouldy on the plants before it was ripe, even if the plants fruited at all. Though it seemed possible that there might be a few varieties that could be grown for seed production in Great Britain, the bulk of those cultivated in the more favoured countries proved themselves definitely unsuitable to British conditions.

Attempts have been made, at least since 1914, to select such suitable varieties, and the work of J. L. North at the old Royal Botanic Society's gardens in Regent's Park resulted in the production of types, several of which ripened in September or the beginning of October. These included a brown type which North called 'Brown *C*', and a group of different coloured kinds which he termed 'Jap'. Further, W. Southworth, previously of the Manitoba Agricultural College, settled at Rothamsted in 1932, bringing with him a type derived from the well-known American soya bean 'Ogemaw' and some others, and under his general supervision several of these and North's also have been grown almost every year since then at Rothamsted and Woburn.

The results of these trials with some of the most promising types in existence have not been encouraging for the prospects of the soya bean as a commercial crop. It seems, in fact, to demand three conditions which we cannot give in full measure in Great Britain. In the first place, being rather sensitive to frost, it cannot be sown until serious danger in this direction is over. In 1935, for example, I sowed several varieties on April 25, and a spell of cold weather in May, accompanied by frost, severely checked the early growth though it did not kill the plants. All the varieties I used seemed to be affected. There is clearly danger, except in the extreme south of England, in sowing before the end of April, and this substantially reduces the length of the possible growing season.

Even more important is the second condition demanded by the plant. The soya bean crop seems to require a 'continental' summer, that is to say, a period of higher temperature while it is growing than we can let it have in Britain. Sir John Russell has recently compared, for example[4], the mean monthly temperature during the growing season at Kleinwanzleben (where soya beans have been successfully grown) and at Rothamsted, with the results shown in the accompanying table.

Mean Temperature (Fahrenheit)

	April	May	June	July	Aug.	Sept.
Kleinwanzleben	48·3	53·9	61·3	66·1	65·6	59·8
Rothamsted	44·8	52·5	56·2	60·4	59·4	55·7
Difference	3·5	3·4	5·1	5·7	6·2	4·1

It is this additional warmth that enables the more continental climate of Kleinwanzleben to grow soya beans better than Rothamsted. The same result is brought out if we compare the length of the growing season of certain known varieties. For example, the variety 'Mandarin' is stated by Piper[5] to ripen in 100 days : at Woburn it took 171 days to give me ripe seed. The variety 'Manitoba Brown', reputed to ripen in 85 days, took, with me, 144 days. All these figures would seem to tell the same tale, namely, that summers in Great Britain are not warm enough for the generally used types to give the best results. In summers that have been wet and sunless, such as that of 1936, we were scarcely able to ripen any seed even of the most successful varieties either at Rothamsted or at Woburn.

Thirdly, the time of ripening should not be later than the first week of October, and preferably the last week of September. If later than this, with the wet autumns that are a feature of the British climate, the chance of drying the ripened crop so that it can be stacked or threshed is small. In the year 1935, for example, I was able to reap the variety 'Manitoba Brown' on September 21, and got it in good condition. The later variety 'Mandarin' was only cut on October 21, yet at this date the beans were not thoroughly ripe, but rather soft.

In spite of these difficulties, certain varieties have been successfully cultivated in a series of years. Recently, Dr. H. Hunter of the National Institute of Agricultural Botany at Cambridge has pointed out that he has got two varieties, namely, 'Brown *C*' and 'Jap', which have a tolerable chance of ripening in Great Britain. Our results entirely agree with his, both at Rothamsted and at Woburn. The 'Jap' types, however, though they have certainly ripened, are very feeble growers. The Brown type, which we call 'Manitoba Brown', but which seems to be identical with Hunter's '*C*', has done better, and in most years since 1934 I have been able to get a normal ripening of good seed, though with a much longer growing season than is customary in Canada, from which country the seed is derived.

But I have never been able to get a yield of seed comparable with what seems to be usual in Manchuria, in the United States, or elsewhere. The yield, in fact, recorded in Manchuria, Japan and the United States runs about 15 cwt. per acre, whereas I have not been able to get more than a maximum of about 6 cwt. per acre of clean seeds. In the course of my trials, I early found that soya beans would not grow at all well unless the land were at least of average fertility. The common idea that the crop can be grown on poor land and reliance placed on its leguminous character to obtain large healthy plants when nitrogenous matter is deficient in the soil is incorrect. Now, I always use soil which has been well manured with farmyard manure some months before planting, and, in 1940, I also used a small dressing of sulphate of ammonia at the time of seeding. But, in spite of this, as already stated, I have never been able to get a large yield. My best was 635 lb. of clean seed per acre in 1938, with the 'Manitoba Brown' variety. Other types which have ripened successfully at Woburn have been 'Black Jap', 'Green Jap', and one obtained from Japan by Southworth called 'Tokio Brown'. All these were less luxuriant than 'Manitoba Brown', and certainly were not earlier. None of them gave me more than 300–400 lb. per acre, the 'Black Jap' being the best.

In order to reach even this yield, the seed was sown between April 25 and May 15. In an average season, probably about the first week in May is the best time. I have always dibbled the seed in rows eighteen inches apart, the dibbles being from six to nine inches apart in the rows. For a non-luxuriant type like all those mentioned, this is probably, if anything, too wide seeding. I have never had any difficulty with germination, but the young plants are very attractive to all sorts of vermin. If growth is normal, the flowers appear on the lower parts of the plants about the middle of July. In 1940, I noticed them on July 22, and flowering was continuous from that date. On August 9 there were clusters of pods on the lower part of the stems and very small pods on the upper parts. When the crop is ripening, the leaves all fall off, and, when ripe, there are practically clean stems with the pods on them. The varieties with which I have been successful have ripened at the end of September, and they were then cut, spread to dry, and, when dry, were at once threshed.

A yield such as I have obtained is not encouraging for the development of a commercial soya bean culture. In spite of the fact that the seed contains between 16 and 20 per cent of oil (of which it is usually counted that 15 per cent is commercially recoverable), and that it has certain other advantages such as its tasty character, it would, at present, pay better to grow the ordinary field bean unless the yields I have obtained can be increased very largely. This small yield in conditions obtaining in Great Britain has, up to date, discouraged even the most enthusiastic growers.

The possibilities for the future seem to depend on the development of types which yield more heavily in our climate than any of those tried hitherto and which are still early enough to ripen at least by the first week in October, and on finding cultivation methods which give again a larger yield than those I have hitherto adopted. I am not unhopeful of the chances in both these directions, but a very great deal of work will be required before the cultivation of the soya bean can take a large part in ordinary farming practice even in the south of Great Britain.

[1] Empire Marketing Board. Publication E.M.B./*C.*/4. (1932).

[2] Imperial Economic Committee. "Vegetable Oils and Oilseeds' (1938).

[3] See Russell, E. J., *J. Min. Agric.*, 43, 24 (1936).

[4] *The Times*, March 12, 1941.

[5] Piper, C. V., "The Soybean", p. 167, New York (1932).

PROBLEMS OF THE MOTIONS OF SOLAR PROMINENCES

BY M. A. ELLISON

YEARS of great solar activity, like those of 1937–38, stand out as landmarks in the advance of our knowledge concerning the phenomena of the solar chromosphere. The quantitative study of prominence motions is little more than twenty years old and derives the greater part of its observational material from the peak years (1926–27 and 1937–38) of the last two solar cycles. Indeed, the recent studies by Max Waldmeier[1] with the spectrohelioscope suggest that at times of maximum activity great eruptive prominences occur on the average about once a day somewhere in the solar chromosphere. They may form the normal, though dramatic, end-phase in the life of every quiescent prominence.

Because of their great size and amazing speed, the eruptive prominences have been more extensively investigated than those of the other four main types; yet we are still without an acceptable theory which will explain, even qualitatively, the characteristic and well-marked stages in their life-history. They originate in all solar latitudes, and show no preference for the sunspot zones, where either the intense magnetic fields of the spots or the occurrence of chromospheric eruptions, emitting ultra-violet radiation, might provide a satisfactory basis for a theoretical discussion of their movements. As an example we may quote the case of the great prominence of September 17, 1937, whose "crowded hour of glorious life" was photographed at the McMath-Hulbert Observatory. This rose in 80 minutes to a height of 1,000,000 km. above the sun, attaining at the end of its trajectory a maximum speed of 728 km./sec. It must be admitted that this is a record for such objects in speed, though not in height; it forms the only example, certainly observed, of matter leaving the chromosphere with a speed in excess of the escape velocity of 617 km./sec. It is a thrilling moment for any solar observer when a quiescent prominence, perhaps 100,000 km. in length, begins to rocket upwards in the field of the spectrohelioscope; and within the past few years these events have been made visible to a wider audience by the superb films of solar phenomena which we owe principally to Dr. B. Lyot of Meudon, and Dr. R. R. McMath and his co-workers in America.

Observations of eruptive ascents were first collected together by Dr. Edison Pettit, of Mount Wilson Observatory, in a celebrated series of papers[2]. His catalogue now includes some fifty examples for which the photographic records are sufficiently complete to enable height-time diagrams to be plotted. On the basis of the earlier observations the following laws of motion were formulated:

Law 1.—The motion of a portion of a prominence or of a prominence as a whole measured along its trajectory is uniform, increasing suddenly at intervals as if by impulse.

Law 2.—When a change of velocity takes place, the new velocity is a small whole multiple of the old. Occasionally the *last* velocity is a whole multiple of the second previous.

Concerning these two laws there has been much controversy, and they have undoubtedly provided a great stimulus to research. Dr. McMath observes: "To say that these curious laws of prominence motion are mysterious is very definitely an understatement. They contradict every known law of the motion of particles under the action of a gravitational attracting centre; it is as though acceleration in prominences functioned only in 'definite acceleration quanta' "[3]. The nature of this motion is illustrated in Fig. 1, which may be regarded as being typical of the height-time diagrams for eruptive prominences. The initial upward velocity of 10–50 km./sec. is represented by the constant gradient AB. Sudden changes of velocity occur at points like B, C where the abrupt

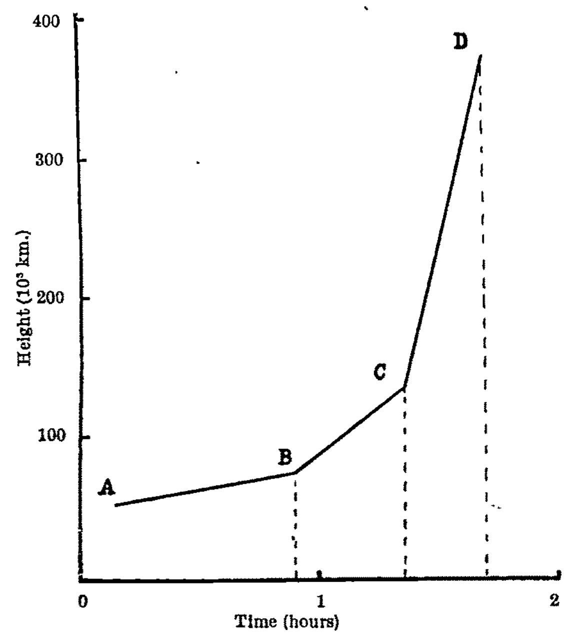

Fig. 1.

changes of gradient (*Knickstellen*) indicate velocity increases which (according to Pettit) are small whole multiples of the original. It has been shown that these changes occur in periods of less than 1 minute and that they are separated by intervals which tend to become progressively shorter as the prominence rises. As many as five such changes have been recorded in a single ascent.

The earlier records were obtained exclusively by photography with the conventional type of spectroheliograph in light of the H and K lines of calcium or $H\alpha$ of hydrogen. The usefulness of this method of following rapidly changing structures was limited by the need for long exposure intervals of 4 or 5 minutes ; short-lived changes were lost and measures of height became insufficiently frequent. A great advance was therefore made in 1933 by Dr. McMath[4], who combined a standard motion-picture camera with the visual spectrohelioscope developed by G. E. Hale, leading at once to the possibility of more rapid and automatic operation. So successful were these preliminary experiments with the spectrohelio-cinematograph that they were followed very soon by the building of the 50-ft. tower telescope and automatic spectrographs of the McMath-Hulbert Observatory[5], Lake Angelus. Difficult technical problems had to be overcome, such as the provision of a precision drive to the 22-in. cœlostat mirror which would keep the image of a prominence fixed at a definite point in the film frame throughout the day, and the construction of timing and exposing devices.

With the completion of this powerful unit in 1937, it became possible to obtain as many as one thousand pictures a day of a single prominence, exposures being of 10–30 sec. with a 'dark-time' of a few seconds in between. The films have been shown in Great Britain before the Royal Astronomical Society and also during the Cambridge meeting in 1938 of the British Association. When they are projected in the usual way at 16 frames per second, there is a speeding up of the original events by about 500 times, from which one may gain a remarkable insight into these weird and complicated movements. One result has been to confirm what was first pointed out by H. W. Newton[6], that the downward movements greatly predominate over the upward, and several new types of prominence have been added to the existing classification. Of these, perhaps the most puzzling are the so-called 'coronal prominences', consisting of matter which first becomes luminous at heights of 250,000 km., or thereabouts, and then pours down in slender columns into centres of attraction in the chromosphere. The downward movements are usually unaccompanied by any visible upward flow to sustain them.

For purposes of measurement, the cinematograph pictures were projected on to a ground-glass screen, 20 cm. × 25 cm., from which the distances moved by selected knots or streamers could be read off along suitable scales. It then became possible to extend the work to the movements of other types of prominence, in particular the class III, or spot-type, of the Pettit classification, with results which, it was claimed[7, 8], demonstrated that all obeyed the two laws of motion. This conclusion has been challenged by H. R. Hulme[9], who bases his criticism upon an analysis of some of the space-time diagrams for descending matter drawn by McMath and Pettit. He shows that these are composed of points which might equally well be fitted by smooth curves rather than by straight lines, and concludes that "the second law is unfounded, and that the application of the first law to the case of descending streamers is not yet justified".

Undoubtedly one of the great causes of uncertainty in this work arises from the fact that the photographic records are two-dimensional. However uniform may be the movement of a prominence streamer along its own trajectory, its velocity will not appear uniform if the plane containing the trajectory is steeply inclined to the normal plane ; and it is here that the spectrohelioscope, used for visual observations of the chromosphere and prominences, has proved of great value. In this instrument the Doppler effect can be utilized in a simple way to measure the line-of-sight velocity of prominence features on the sun's limb, or when seen projected as dark hydrogen absorption flocculi on the disk. Waldmeier[1] has thus been able to obtain a three-dimensional picture of the movements of some of the eruptive prominences observed at Zurich, and he concludes that the second law of Pettit does not hold for the eruptives. The direction of future advance would therefore seem to rest with the possibility of developing a technique for the automatic recording of line-of-sight velocities in such a manner that they can be combined with those obtained from the two-dimensional photographs. Furthermore, when prominences are observed with the spectrohelioscope and are seen as absorption markings projected against the solar disk, curves may be plotted between the line-of-sight velocity and the time. Near the centre of the disk, if the prominence is moving vertically in the chromosphere (as may often be demonstrated by the absence of simultaneous lateral movements), the velocity-time curve will give a true picture of its motion[10].

The remarkable films taken by Dr. Lyot differ from those of the American workers in being direct photographs of solar phenomena. Through superior technique, Lyot has achieved success[11] in this direction where earlier attempts conspicuously failed; and he has been able to develop the coronagraph, in which instrumental diffusion of light has been reduced to a minimum. With such an instrument situated in the clear air of the Pic du Midi, 9,000 ft. above sea-level, photographs of prominences may be taken through suitable filters on many days of the year. In one important respect the method is superior to the use of the spectroheliograph; for the absence of any narrow selecting slit (inherent in the spectroheliograph) allows a record of prominence streamers with high radial velocities to be obtained at the same time as those with little or no radial velocity. The general agreement between the two methods is therefore most satisfactory, since it indicates that radial velocities of 100 km./sec. or more, which would shift the image right off the second slit of the spectroheliograph, are comparatively rare in ordinary prominences.

Numerous attempts have been made to provide a theoretical basis for the first law of motion, bearing in mind the nature of the forces which atoms in varying degrees of excitation may experience in the chromosphere. At the very least we must take into account the effects of gravitation, light-pressure, magnetic fields and frictional resistance.

An attractive starting-point is to assume that in the chromosphere and prominences gravity is balanced by light-pressure; calculations of the magnitude of the light-pressure indicate that this is so, though it must be admitted that we are not sufficiently certain of the processes involved to be assured of the result. In any event, if such an equilibrium does exist, it must be expected that the Milne effect will frequently intervene to upset it. Milne[12] proposed that when a prominence began to rise by reason of some small local disturbance in the chromosphere, its absorbing line would shift to the violet in consequence of Doppler effect; here it would encounter the much more intense continuous spectrum with corresponding increase in light-pressure. A condition of instability would be the result, the prominence continuing to rise with *accelerated* velocity. Pettit and McMath[8] have worked out in detail the consequences of this instability, taking into account the known contours of the K and H absorption lines, and have shown that it would lead to a height-time diagram which is a continuous curve, quite unlike the observed movements of the eruptive prominences. Moreover, the great difference in masses of the atoms of hydrogen and calcium should tend to produce a considerable separation of these gases during the ascent. This has never been observed; indeed the spectroheliograms taken by light of the two different wave-lengths have always shown the images to be remarkably alike.

K. O. Kiepenheuer[13] has considered the motion of prominence material to be expected in the magnetic field of a sunspot, and he arrives at a result for the knots and streamers of class III (sunspot-type) prominences which indicates uniform motion. He finds also that the motion of the eruptive prominences is consistent with the supposition that their atoms receive energy intermittently by absorption of ultra-violet radiation, having its origin in frequent chromospheric eruptions. Against this must be recorded the fact, demonstrated both by Pettit and Waldmeier, that the change-over from one uniform velocity to the next in an eruptive prominence occurs in a period that does not exceed one minute, while the average duration of observed chromospheric eruptions is about twenty minutes. Furthermore, the chromospheric eruptions are very definitely confined to the sunspot zones, while the eruptive prominences are not.

It is evident that a workable theory for prominence motions is one of the great needs in solar physics to-day.

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SPECIFICATIONS FOR NATIONAL FLOUR

THE Accessory Food Factors Committee of the Lister Institute and the Medical Research Council, in a memorandum issued in the summer of 1940, recommended the adoption for bread of a flour of 80–85 per cent extraction of the wheat, in the following terms : "Flour for the bread of the people should contain the germ of the wheat grain, as much as possible of the aleurone layer, and the finer portions of the bran. Instead of flour consisting of about 70 per cent of the wheat grain, as it does at present, the percentage extracted should be at least 80 to 85 per cent".*

Since this recommendation was made, the Ministry of Food has decided to make generally available to the public bread baked from flour of 85 per cent extraction.

In the original memorandum the nutritional considerations on which the recommendation was based were set out. It now seems desirable to re-state them, incorporating the results of further research and defining more exactly the character of the particular 85 per cent extraction flour recommended by the Committee.

SPECIAL NUTRITIVE PROPERTIES OF THE SELECTED FLOUR

The degree of extraction was fixed at 85 per cent in order to secure a flour which should contain :

(1) As much as possible of the B vitamins including riboflavin and nicotinic acid and especially of vitamin B_1, present in the whole wheat.

(2) As much protein as possible, including a high proportion of that situated in the outer layers of the grain. This protein is known to possess a higher nutritive value than that contained in white flour.

(3) As little bran as possible so that there should be no risk of loss of nutritive value due to presence of much indigestible material. War-time diets already contain much vegetable food with relatively large amounts of roughage ; it is undesirable to increase this further.

PRODUCTION OF FLOUR OF 85 PER CENT EXTRACTION

Flour of 85 per cent extraction can in practice be obtained by two general methods : (1) by rearrangement of the milling machinery to produce a flour containing 85 per cent of the wheat, or (2) by addition to the white flour (73 per cent extraction), obtained in the ordinary milling processes, of combinations of the other fractions of the wheat.

The consideration which has influenced the final selection of the flour to be adopted has been the need to combine two qualities : first, the best nutritive value and, secondly, the production of a loaf as little removed as possible in colour, texture and flavour from that of ordinary white bread. Two flours, prepared respectively by the above methods (1) and (2) were selected as possessing equal nutritive value, the first, however, being preferable as fulfilling the second condition most perfectly. Flour (1) was selected as the best for the following reasons :

(*a*) Of all flours obtained at the same level of extraction by different methods from the same grist, it had the highest vitamin B content and in this respect closely approached that usually accepted for wholemeal bread.

(*b*) It had the lowest fibre content compared with other flours extracted at this level from the same grist.

(*c*) Of all the breads tested, baked from 85 per cent flour, it yielded the one which resembled white bread most closely in flavour and texture.

(*d*) The colour of the bread was pale brown and was not unattractive.

(*e*) On technical and on æsthetic grounds the loaf baked from it was considered excellent.

DEFINITIONS FOR TWO SELECTED FLOURS

Flour (1).—This straight-run flour may be defined as a flour containing 85 per cent by weight of the clean wheat, in which is included (*a*) the maximum amount of the germ and of the aleurone layer and (*b*) the minimum of the pericarp, as shown by its low fibre content.

Flour (2).—May be defined as (*a*) containing 85 per cent of the weight of the clean wheat grain in which is included all the white flour, all the reduction roll tails, mill finish and purifier tails and sufficient fine bran to bring the amount of the mixture up to 85 per cent of the clean wheat ; (*b*) containing 85 per cent of the clean wheat and excluding 15 per cent consisting of the bran and pollards.

Analyses of samples of flours (1) and (2) are set out in the accompanying table below, with those of white flour of 73 per cent extraction and of wholemeal flour, all four materials being derived from the same grist (water content being 15 per cent).

Samples of flours (1) and (2), obtained from the same grist, were found to be similar in content of protein, ash and vitamin B_1, which in both cases was more than 1 I.U. per gm. (thiochrome methods). The fibre content of both flours was less than 0·9

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*See also NATURE, 146, 117 (1940).

Flour	Fibre %	Ash %	Protein %	Vitamin B_1 International Units per gm. (thiochrome method).	Calcium mgm. %	Phosphorus mgm%	
						Total	As phytic acid.
1 (85%)	0·60	0·90	11·4	1·2	27	203	123
2 (85%)	0·85	0·94	11·5	1·15	27	211	128
White (73%)	0 to 0·20	0·46	10·6	0·35	15	101	35
Wholemeal (100%)	1·8	1·51	11·9	1·4	36	343	246

per cent that of flour (1) being lower than that of flour (2). The lower the fibre content the better is the flour and the more efficient is the milling.

KEEPING PROPERTIES

No exact evidence is as yet available regarding the keeping properties of the particular types of flour selected, but from the experience gained of other brown and wholemeal flours there is little doubt that this flour of 85 per cent extraction could be kept in good state under reasonable conditions of storage for 4–6 weeks or longer.

RECOMMENDATION 1

The Accessory Food Factors Committee, at its meeting on January 23, 1941, recommended that a flour of 85 per cent extraction (similar to flour (1)) should be adopted.

Since modification of ordinary milling machinery would be required for production of flour (1) and this would take time, it was further recommended that a flour of 85 per cent extraction (similar to flour (2) should be adopted in the meantime, as this could be produced without any delay. The flour should not contain less than 1 I.U. vitamin B_1 per gm. and the fibre should be less than 0·9 per cent (assuming a water content of 15 per cent).

ADDITION OF CALCIUM SALTS

It is known that the intake of calcium salts in the diets of Great Britain, especially among the poorer classes, is frequently below the minimum accepted by nutrition experts as necessary for satisfactory growth of bones and teeth in growing children and for maintenance of the bones in adults. The addition of calcium salts to bread was recommended in the previous memorandum issued by the Medical Research Council. It is now possible to add details concerning the amounts required.

Wholemeal bread and bread made from flour of 85 per cent extraction contain more calcium than white bread and also more phosphorus. A large proportion of the phosphorus, however, is present in a combination (phytic acid) in which it is not directly available to the organism and at the same time diminishes the availability of the calcium present in the bread and in the rest of the diet. Recent tests made on human subjects for the Medical Research Council have shown that to maintain a sufficient supply of calcium salts for health more calcium salts must be added to the diet. The most convenient way to do this is to add calcium carbonate to the wheat flour used for bread. As a result of the above tests on human subjects who consumed about one half of their total calorie intake as bread with only small amounts of milk and very little cheese, it has been calculated that additions are needed of 65 mgm. calcium per 100 gm. white flour (7 oz. of calcium carbonate as *creta præparata* B.P. per 280-lb. sack) and of 130 mgm. calcium per 100 gm. flour of 85 per cent extraction (14 oz. calcium carbonate per sack). In the case of the 85 per cent extraction flour the extra 7 oz. per sack is required to neutralize the effect of the extra phytic acid contained in flour of this degree of extraction.

It has long been a practice in baking to add similar amounts of substances known as 'improvers' (for example, acid calcium phosphate 12 oz. per sack, or up to 4½ lb. per sack, in case of certain self-raising flours at present on the market).

The addition of the recommended amounts of calcium carbonate to flour has no effect on the vitamin B_1 content of the flour or on its baking properties.

RECOMMENDATION 2

It is recommended that calcium carbonate (as *creta præparata* B.P.) should be added to the wheat flour from which white bread is made in the proportions of 7 oz. per sack (280 lb.) of white flour and of 14 oz. per sack of 85 per cent extraction flour.

ADDITION OF IRON SALTS

The desirability of adding iron in some form to flour has been considered, the reason being that anæmia due to insufficient iron in the diet is common in Great Britain and could easily and cheaply be prevented by administration of simple ferrous salts. A study of the available data on this subject has, however, led to the conclusion that the presence of added iron salts in flour might cause destruction of some of the other nutrients present. It is, therefore, not recommended that any such additions be made until further knowledge on this point is available.

ADDITION OF 'IMPROVERS'

The addition of certain 'improvers' to bread baked from flour of high extraction facilitates the work of the baker and results in a more attractive loaf. Such evidence as is available does not justify at this stage the prohibition of their use in the baking industry and the question has therefore been left open.

OBITUARIES

Sir Albert Seward, F.R.S.

We regret to record the death of Sir Albert Seward on April 11 at the age of seventy-seven. Albert Charles Seward achieved outstanding success as an investigator, a teacher, a writer and an administrator. Most of his life was spent in Cambridge, where the University and two of its colleges owe much to his untiring energy, but his work also extended over a much wider field and few scientific men have been so widely known and so universally popular.

Born at Lancaster in 1863, he was educated at Lancaster Grammar School and St. John's College, Cambridge, of which he was three times a fellow. From his school days he was devoted to the study of botany and geology, and his border-line researches benefited both sciences. His early interest in fossil plants was stimulated by W. C. Williamson, the founder of modern palæobotany in Great Britain. His first papers appeared in 1888, to be followed by more than 160 contributions to periodicals, dealing with plants of all types and ages, as well as several important books. The first of these, his Sedgwick Prize essay on "Fossil Plants as Tests of Climate", opened up an interesting palæogeographical problem to which he made other valuable contributions later. Afterwards he devoted special attention to the floras of Mesozoic times, producing a series of British Museum catalogues (1894–1904) as well as studies on Mesozoic plants from all over the world. His text-book, "Fossil Plants", in four volumes (1898–1919), will long remain a standard work of reference. It contains a mass of information assembled from widely scattered sources and is a survey of the subject of great value to future workers. "Plant Life through the Ages" (1931) was a more concise study of the field with special reference to its bearing on some of the general problems of botany and geology.

In addition to books for specialists his facile pen produced several excellent semi-popular books, the last, a work on modern geology, being completed only two days before his death. With Sir Francis Darwin he edited "More Letters of Charles Darwin", and he edited a fine volume entitled "Darwin and Modern Science" for the jubilee of the "Origin of Species". He edited an interesting volume on "Science and the Nation" (1917) and acted as general editor of the Cambridge Botanical Handbooks and of other series produced by the Cambridge University Press.

The teaching and advancement of botany at Cambridge owes much to Seward's ability as a lecturer and administrator. He was appointed University lecturer in botany in 1890 and succeeded Marshal Ward as professor in 1906. At that time the Department of Botany was rapidly expanding, and the School continued to progress and expand throughout the thirty years of his professorship. A few years before his voluntary retirement from the chair he saw a notable addition to the laboratories built, equipped and opened. He was concerned in much useful reconstruction and reorganization in the Botanic Garden, which continues to be one of the finest University gardens in the world. He saw the Cambridge Botany School become a centre of research to which post-graduate students came from all parts of the world.

During many years Seward devoted part of his energies to college work. As fellow of Emmanuel and tutor from 1899 until 1906 he guided the studies of many who have made reputations as men of science. From 1915 until 1936 he was Master of Downing, a foundation noteworthy as a place of scientific education. His mastership marks an epoch in the history of the College, which not only maintained its scientific and legal traditions but also made great progress in literary and artistic studies.

Work as a professor and master led to many other administrative responsibilities in the University, to membership of many boards and syndicates, of the council of the Senate, and eventually to the office of Vice-Chancellor at a most important period. But all this did not prevent him from taking an active part in work outside Cambridge. Always a strong supporter of the British Association and often a member of its Council, he was twice president of Section K and in 1939 of the Association. Having been elected to the Royal Society in 1898 he served for two periods on its Council and was foreign secretary and vice-president from 1934 until 1940. He was awarded the Royal and the Darwin Medals. From 1922 until 1924 he occupied the presidential chair of the Geological Society, which awarded him the Wollaston Medal. He played a great part in the organization of the Fifth International Botanical Congress, over which he presided, and he was president of the International Union of Biological Sciences in 1931. He was chairman of the Scott Polar Research Institute and also of the Fenland Research Committee. After leaving Cambridge on his retirement in 1936 he spent much time in valuable work at the British Museum, of which he became a Trustee; he also became an active member of the Advisory Council for Scientific and Industrial Research.

One other lifelong interest must be mentioned that was probably connected with the liberal principles which he so strongly held. He thought that the knowledge of science and the interest which it contributes to life should be made available to many outside the older universities. He acquired much of his power as a lecturer at the outset of his career by delivering university extension lectures, and these courses had a very stimulating influence on the study of geology in the north of England. Later he became president of the Yorkshire Naturalists' Union, and took an active interest in the establishment of the University College at Hull. He was president of the Union of South-Eastern Scientific Societies in 1935, and of the Science Masters' Association in 1929. He worked for the establishment of a first-class journal of popular science, assisting in the management of *Discovery*, and contributing frequently to it.

Many well-merited honours came to Seward from academic bodies and scientific societies at home and abroad, and he was knighted in 1936. He had a singularly happy home life; his house was a place where many men of science have received a warm welcome and of which they have happy memories. Reminders of his genial personality remain in two excellent portraits in Cambridge, one in the hall of Downing College, the other in the Botany School.

H. HAMSHAW THOMAS.

Prof. J. S. Macdonald, F.R.S.

JOHN SMYTH MACDONALD was born in 1867. He was educated at King's School, Chester, and at Emmanuel College, Cambridge, where he took his B.A. (Math. Tripos) in 1889. In 1891 he was appointed Holt research fellow in physiology at Liverpool, and in 1897 he took the Scottish conjoint diploma in medicine. After qualification he was appointed assistant lecturer at Liverpool under Sherrington, who described the work of his Department during 1899 in the following terms: "The Department of Physical Physiology has . . . devoted most of its attention to the students, but Mr. J. S. Macdonald, the Assistant Lecturer in the subject, has also been engaged in active original research, the results of which, it is hoped, he will publish in an early number of these reports. Much work, however, has been spent in the preparation of systematic lectures, which have, indeed, been more of the nature of lecture demonstrations. The time spent has been very considerable, but now that the course with its experiments has once been arranged, it will require to be varied only in small details from year to year." The report adds that for the first time lady students had attended the classes: three ordinary students and one training for teaching. Among such men as Sherrington, B. Moore, O. Lodge and others Macdonald was fortunate in his colleagues.

The work to which Sherrington referred was published in 1902 and covered 135 large pages. It concerned "The Injury Current of Nerve". Using this as a test for the state of a nerve, Macdonald noted the changes produced in it by alteration of ions or of osmotic pressure in the surrounding fluids. By this work he took his place among the pioneers of British electrophysiology and physical chemistry applied to living tissues.

During the next few years, Macdonald published a series of articles in which he applied micro-chemistry to the investigation of nervous tissue. Using A. B. Macallum's cobalt method, he found that potassium was present not only at the point of nerve section and at the nodes of Ranvier, but also at any point where the nerve might be injured, for example, by drawing a hair tightly across it while it lay on the microscope stage. He investigated along similar lines the chloride distribution when mammalian or frog nerve was immersed either in solutions of different ions or of different ionic strengths, and he explained many previously mysterious histological findings. He showed that the axon fibrillæ were artefacts.

Macdonald began to apply the same methods to muscle, but was diverted (perhaps by its promise of scope for his mathematical powers) to the study of human energy exchanges. While professor of physiology at Sheffield he found the money with which to build there a human calorimeter room modified from the "Middletown calorimeter" described by Benedict. (This calorimeter was recently accepted by the Wellcome Medical Museum.) He set himself to study in turn the form of the curve of heat output in man during prolonged steady work on a bicycle; the relation during successive periods of work between a man's weight or his surface area and his mechanical efficiency, and finally the energy cost of different movements in work. After several papers had appeared in the *Journal of Physiology* and in the *Proceedings of the Royal Society*, Macdonald was elected a fellow of the Royal Society in 1917.

During later years Macdonald's health was unsatisfactory, and, though he retained a strong interest in the problems of muscular exercise, he gave most of his strength to the routine duties of his department. He had followed Sherrington as professor of physiology at Liverpool in 1914 and, on his retirement in 1932 at the age of sixty-five, he was appointed emeritus professor. For a time he lived near one of his sons who practised veterinary medicine in Lincolnshire, and more recently he moved to Bridge of Allan, where he died on March 29.

C. E. BRUNTON.

The Right Hon. Lord Austin, K.B.E.

BY the death of Lord Austin on May 23 at the age of seventy-four, the world has lost a great industrialist-philanthropist. As an industrialist, his name has become a household word which conjures up visions of the early small 'family' car; he was also a liberal benefactor of hospitals. Scientific workers, however, will also recall his munificent gift in 1936 to the University of Cambridge. His imagination, fired by the progress achieved by Lord Rutherford and colleagues at the Cavendish Laboratory, he gave the University approximately £250,000 for the development of the work of the Laboratory. Work on atomic physics had progressed to the stage, culminating with the demonstration by Cockcroft and Walton of the artificial disintegration of lithium, when it had become apparent that further advance involved the use of apparatus on an engineering scale. The University realized the need and also the desirability of improving facilities at the Cavendish in other ways, and had issued an appeal for a quarter of a million sterling, to which Lord Austin's gift was the splendid response.

The death of far-seeing captains of industry of the type of Lord Austin must always be a grievous loss to the world.

NEWS AND VIEWS

Royal Society of Arts: Albert Medallist

THE Council of the Royal Society of Arts has decided to confer on President Roosevelt the Albert Gold Medal of the Society in recognition of his prominent services to humanity as the fearless and resolute champion of the ideal of national freedom and individual liberty. The Albert Medal was struck in 1864 to commemorate Prince Albert's presidency of the Society during 1843–1861. It is awarded for "distinguished merit in promoting arts, manufactures, and commerce".

This award came very fittingly just in advance of President Roosevelt's declaration of a state of unlimited national emergency in the United States and of his long-awaited pronouncement on American policy in relation to the War. In effect, Mr. Roosevelt has now assumed powers which are as far-reaching as those wielded by the dictators of the totalitarian States, but with this significant difference; the dictators seized unlimited powers, whereas Mr. Roosevelt's mandate comes from the American people, who elected him president under a pledge that he would take all necessary measures to safeguard democracy in their country, and give all possible aid to the democratic nations now opposing Nazi aggression. He derives his powers from the people, who have voluntarily surrendered to him their liberties in the knowledge that the present crisis in world affairs requires swiftness and unity of action such as can be accomplished when authority is concentrated in the hands of the few; when the emergency passes with the suppression of Nazism, there are sufficient safeguards in a democratic community to ensure the effective restoration of individual liberty. The position of the United States is now similar to that in Great Britain. In his speech, Mr. Roosevelt re-affirmed the principles of democracy against the background of the story of Nazi oppression and intrigue, and asserted that freedom for the world goes with "Freedom of the seas". The United States will take all steps to provide supplies for the democracies, and will see to it that the supplies are delivered: "This can be done and must be done. It will be done."

Linnean Society of London: Gold Medallist

THE Gold Medal of the Linnean Society of London was presented to Prof. A. G. Tansley, emeritus professor of botany in the University of Oxford, at the anniversary meeting held on May 24. The Medal, which is awarded annually to "an eminent biologist as an expression of the Society's estimate of his services to science", is a fitting recognition of Prof. Tansley's contribution to ecology, and particularly to the development of the subject in Great Britain. The recent publication (1939) of his monumental work on "The British Islands and their Vegetation" rounds off an epoch in plant ecological work in Great Britain. The award of the Medal at this time thus seems particularly appropriate. Tansley's reputation as a fern anatomist was already made when, in 1904, he became one of the small group of enthusiasts, who, under the cumbrous title of the "Central Committee for the Survey and Study of British Vegetation", began systematic ecological work in Great Britain. His special contributions have been to the study of the vegetation of the English chalk. But his contribution to ecology has been far greater than his studies of particular plant communities. From the outset, Tansley was able to place his great gifts as editor and critic at the service of the committee. In 1902 he had founded a British botanical journal, the *New Phytologist*, as a private venture. For thirty years he owned and edited it. It was, and is, the avowed policy of the journal to open its pages to summaries of branches of botany "undergoing current rapid development". The British Vegetation Committee thus had a platform, controlled by one of its number, available for the discussion of concepts and principles upon which the new study should develop.

In the world of those days, international co-operation was possible. Tansley was one of those who realized the importance of personal contacts and frank discussion between the leaders of a new branch of science in different countries, if development was to proceed on right lines. He had much to do with the organization, in 1911, of the first International Phytogeographical Excursion, a memorable and ambitious tour of the British Isles, by a party of distinguished American and Continental ecologists. It was in this year, too, that Tansley edited and in large part wrote "Types of British Vegetation", a work that for many years was invaluable in interpreting British vegetation to botanists at home and abroad. When, in 1913, the British Ecological Society was founded, it was natural that Tansley should be its first president. It was not then expected that he should, in 1917, take over the secretary's work and editorship of the Society's *Journal*. This he did, and, for twenty-one years, Tansley, under his Council, guided the destiny of the *Journal of Ecology*. Its high standard, both in original papers and in critical articles and reviews, many written by him, owes much to his guidance. In 1926, Tansley was co-editor of "Aims and Methods in the Study of Vegetation", a work primarily published to foster ecological work in the Dominions and Colonies along right lines. In the preface to "The British Islands and their Vegetation" Tansley says that the work is largely "compilative". But the fact is that in this work, and throughout his long association with ecology in Great Britain, he has done much more than publish original work, or edit and weld the work of others. He has been the friend, critic and philosophic guide of most ecologists in Britain, and many overseas. That British ecology has in the main avoided some of the criticisms and rigidities of other countries is due in no small measure to Tansley.

Institute of Metals: Medallist for 1941

Dr. C. H. Desch, scientific adviser to the Iron and Steel Research Council, has been awarded the Institute of Metals Medal for 1941, "for distinguished services to non-ferrous metallurgy". It will be recalled that Dr. Desch retired from the post of superintendent of the Metallurgical Department of the National Physical Laboratory at the end of 1939 (see Nature, January 27, 1940, p. 34), after nearly forty years of active participation in metallurgical teaching and research, both academic and industrial. His professional work, however, was not allowed to suppress his early interest in chemistry, and he is the author of well-known books on the chemistry of cement and concrete, on intermetallic compounds and on the chemistry of solids; he has also taken part in the activities of the Institute of Sociology. The Medal of the Institute of Metals which Dr. Desch has now received is given every year and was presented to the Institute by the Mond Nickel Company; it is struck in platinum. Previous recipients of the medal have been Sir William Bragg, Sir Harold Carpenter and Dr. Paul D. Merica, a distinguished American metallurgist.

"I Married Adventure"

A film with the above title is shortly to be generally released throughout the provinces of Great Britain by Columbia Pictures, Ltd. It is a full-length travel film of a similar type to the now well-known "Dark Rapture". But whereas "Dark Rapture" was concerned with the lives, habits and customs of various tribes in the Belgian Congo, "I Married Adventure" deals with expeditions to Borneo and tropical East Africa, and is outstanding not for its photographs of tribal life, but for some quite unique animal scenes. These records were collected over a period of twenty-seven years by the late Martin Johnson and his wife, Osa, the producer of this film. In Borneo they have collected some remarkable shots of anthropoids, ones of particular interest being those of the golden gibbon. There are also some excellent pictures of the small honey bear.

In Africa, Mr. and Mrs. Johnson succeeded in photographing from an aeroplane some shots of animals which were being driven in search of water by thirst. These migratory movements of hundreds of elephants, with their accompanying heron flocks, wildebeeste, giraffes and zebras are shown so clearly that they are as thrilling as they are scientifically unique. The biologist will also be gripped by some interesting photographs of onyxes, with their attendant tick-birds, and specially by a combat to the death scene of two of these onyxes. Yet another outstanding scene is that of a flock of flamingoes packed so closely together in their positions on a lake that only the birds at the edge of the group are able to get sufficient run to be able to lift themselves off the ground with their wings.

This is a film that all biologists will want to see. It must be realized, however, that it contains several jarring features which would need to be overlooked. Many of the entertainment scenes are forced, prolonged and 'unfunny'; the introduction is awkward and unattractive, while technical production falls far below the height which Hollywood has taught us to expect. After seeing the film the biologist's heart will be further saddened when he thinks of the invaluable opportunities presented to Mr. and Mrs. Johnson to secure photographs which would throw light for many of us on the peculiarities of individual tribes. Apparently these opportunities were not taken. A book of the same title (pp. 376 + 71 plates. London and Melbourne: Hutchinson and Co. (Publishers), Ltd., 1940, 10*s*. 6*d*. net) has also recently appeared. People who have seen the film will want to read the book, and *vice versa*. Unfortunately, the book is of limited value to the naturalist. Objective descriptions of natural life are few in number, and the larger part of the book is given over to describing the emotional reactions of the author during her travels.

British Museum (Natural History): Recent Acquisitions

The late Dr. C. B. Ticehurst has bequeathed his important collection of birds to the Department of Zoology. The collection comprises more than seven thousand specimens, mainly from Spain, Portugal, Yugoslavia, North Africa, and north-western India. Mr. D. V. Burnett, of the Rezende Mines, Southern Rhodesia, has presented to the Department of Mineralogy a beautiful plate of crystallized gold, measuring 10 cm. × 9 cm. and ½ mm. thick. This is the largest of a number of similar plates which have been found in cavities along a fault plane at the Old West Mine, Penhalonga Alley, Umtali. The surface of the specimen shows stepped triangular elevations with the crystal form (311), some of which are capped with a crystal stud of silver. Other donations to the Department include montgomeryite and sterretite, two new phosphate minerals from Mr. A. Montgomery, of New York, and a fine set of celestine crystals from Peak Hill, Sidmouth, presented by Miss Lillias A. Cowan.

Eskimo Material Culture

Of recent years serious attention in Great Britain has been paid to the study of the way of life of the Eskimos. Expeditions have been made and material collected. In some cases excavations have enabled investigators to obtain a chronological sequence of industries. As a result the collections in not a few of our museums—the Museum of Archæology and Ethnology at Cambridge for example—have been considerably enriched and many of the finds are still in process of being studied. Naturally American and Canadian museums have not fallen behind in this respect, and a recent article (*Ann. Carnegie Mus.*, Feb. 18, 1941) describes a collection of about a thousand specimens gathered by Eskimos from old camp sites in the Belcher Islands in Hudson Bay and recently received by the National Museum of Canada.

Unfortunately little or no information is available about the circumstances of the finds so it is only possible to apply typological and technological methods of study. Here naturally the earlier work of Mathiassen has proved invaluable. It would seem that some of the objects must predate the historical period while others were clearly made after the introduction of iron to the district and cannot therefore belong to a period earlier than the middle of the sixteenth century and may well be a hundred years younger still. Influences from various outside areas are traced and comparisons made. The Eskimo culture has always had a special interest for prehistorians, for the conditions, and therefore the mode of life, of these arctic folk resemble to a considerable extent those obtaining in Magdalenian times. Comparisons, of course, cannot be pressed too far, but it is at least always helpful to have scientific descriptions and good illustrations of Eskimo implements.

Youth Welfare in Australia

REFERRING to the leading article entitled "Welfare of Youth" in NATURE of November 16, 1940, p. 627, Sir James Barrett, sometime chancellor of the University of Melbourne, and a well-known Australian occulist and surgeon, writes to say that in Australia the National Fitness Movement is getting well under way and relies on two organizations in the main for its efficiency, namely, the American Playground System and the municipalities, the latter item meaning decentralization. The American Playground System is now of vast proportion and aims not simply at physical efficiency but also at moral and mental development, since in competitive games rules are made and must be observed. In short, the aim is self-government.

But no playground in the United States or Australia, he writes, is of much service without trained playleaders who help to organize the activities and to enlist committees of parents who are taught what the movement means and how malnutrition can be avoided. In other words, the movement is a department in effect of the educational system. Dr. Gulick is the soul of the American movement, and those interested should read his work "The Philosophy of Play". The desire for play is innate in the animal kingdom, and is seen even in kangaroos. In human beings it is the mainspring which compels action, and it was the recognition of this fact that brought the modern playground into existence which, whilst originating in England, has been enormously developed and systematized in the North American continent.

Folk-Lore of Pulmonary Tuberculosis

IN a recent paper on this subject (*Tubercle*, **22**, 55; 1941), Dr. J. D. Rolleston states that while engaged in the composition of previous papers on the medical aspects of folk-lore (see NATURE, **143**, 111, 756; 1939) he had been struck by the numerous popular, as distinct from scientific, views concerning pulmonary tuberculosis. He had therefore collected the folk-lore of this disease, most of which was concerned with its prophylaxis and comparatively little with its ætiology and symptoms. As regards the ætiology it is noteworthy that long before it was held by the medical profession to be an infectious disease, pulmonary tuberculosis was regarded as such in some country districts in England as well as among the Karanja Indians and in Brazil. Among the causes of the disease in popular estimation were catching cold, inspiration of a very cold north wind, the sudden cure of skin diseases, especially scabies, and sexual excess.

The last factor accounted for the treatment by administration of the testes of a fox or chicken in folk medicine long before the introduction of endocrinology by Brown-Séquard. Dr. Rolleston classified the various folk-lore beliefs and methods in the prophylaxis and treatment of pulmonary tuberculosis as follows: (1) Transfer of the disease to other persons, animals and inanimate objects; (2) animal, plant and mineral remedies apart from any idea of transfer; (3) religious factors such as invocations to the Trinity, Virgin Mary and various saints, especially Pantaleon; (4) charms of different kinds, some of which dated from Anglo-Saxon times; (5) water in the form of drinking water or bathing in the sea, streams, wells and fountains; (6) one hundred and sixty-one miscellaneous remedies, such as the doctrine of signatures, the influence of the moon, odd numbers and mechanical methods.

Sources of Information on Agriculture

THE Association of Special Libraries and Information Bureaux is issuing a new series of revisions and expansions of sections of its Directory to be known as "ASLIB War-Time Guides to British Sources of Special Information". The first of this series "Fuel and Allied Interests" (excluding electricity) was issued last June. The second, entitled "Agriculture and Allied Interests", is now available ASLIB, 31 Museum Street, London, W.C.1. 5*s*. to members of ASLIB, 6*s*. to non-members). The Guide consists of forty mimeographed foolscap sheets and is divided into four sections. Section 1 summarizes the position of agriculture and describes the organization for agricultural education and research in time of war. Section 2 gives a list of sources of specialized information, indicating the nature of the work carried out and the publications issued by each body. Government and public departments, research organizations, agricultural colleges and university departments come into this category, together with professional and trade organizations and stock breeding societies. The third section provides a comprehensive list of periodicals and year books, those which print abstracts or lists of references being specified. The Guide concludes with a section consisting of subject indexes relating to both section 2 (sources of information) and section 3 (periodical publications). Compilation has been carried out in close collaboration with specialist advisers, and the details concerning the individual organizations have been supplied by the latter themselves.

Forestry in New Zealand

The annual report of the State Forestry Service of New Zealand, drawn up by Mr. Alex. R. Entrican, director of forestry, is a concise document dealing with various forest activities. The great value of the report lies in the attention it directs to the position of the very large area of exotic plantations existing in the country and the difficulties facing their treatment. "A timber famine scare", says the author, "in all English-speaking countries was one of the products of the Great War, and it was perhaps inevitable that under the existing conditions of those times extensive tree-planting with quick-growing exotics should follow. Employment was required for large numbers of repatriated soldiers; then mass-production psychology, born out of munitions and automobile manufacture, favoured large-scale forestry operations. To some degree extensive areas had been planted with unsuitable species or consist of soil fit for neither agriculture nor forestry. The former has often been due to the impossibility of obtaining the amounts of suitable seed required in the general large scramble to plant."

The most serious result, however, is connected with neither of the above. This urgent large-scale planting has been the creation of 750,000 acres of plantations with complete disregard for the essential necessity of creating well-distributed age classes. For example, three State exotic forests totalling 41,000 acres were 91 per cent planted during the five-year period 1927–31. During the same period more than 80 per cent of the total State *insignis* pine stands were planted, and more than 50 per cent of the privately owned stands. It will be obvious to any forester that the correct management of this enormous area of almost even-aged forests is going to prove a difficult problem. As the director of forestry correctly says, only by intensive planning and organization may enormous losses be avoided in these medium-age classes which form such a large proportion of the exotic forest resource. A future better distribution of age classes is obviously an aim. To assist, a recommendation is made that for the present all fellings in indigenous forests should cease.

"Kill Statistics" from California

Game birds and animals form a valuable food resource of any country, but the permanent value of the resource depends upon the skill with which it is at once utilized and husbanded. In California the control of game is supervised by the Division of Fish and Game, and in order that effective regulations may be made it is essential that the Division should know how many individuals of each species are killed in the various parts of the State. In one area a species may be abundant in spite of the sportsman, in another it may require further protection. The method of collecting the information upon which legislation depends is by questionnaire, attached to hunting licence application forms, and the experts are convinced that the returns give a reasonably accurate tale of the slaughter. The statistics for 1938 have been published by J. I. Hunter and Donald H. Fry, jun. and reveal some astonishing numbers (*California Fish and Game*, **26**, 310; 1940). The estimated number of ducks killed was 950,000; geese, 90,000; pigeons (Columba), 95,000; doves (mainly Zenaidura), 1,700,000; quail, 1,500,000; pheasants, 125,000. The mammal numbers are also very considerable: cottontail and brush rabbits, 500,000; jack rabbits, 750,000; deer (two species), 35,045. In 1939, 43,251 deer were killed, a number strongly in contrast with the moderate slaughter of twenty-five years ago, when the estimate of killed reached only 12,000.

Caffelite: a New Plastic

For many years excess production of coffee has been a serious problem for the Brazilian Government; thousands of bags have been deliberately destroyed every year to prevent them coming on the market. Now that markets in Germany, Italy and other European countries are lost to them, the position is even more serious. According to the *Electrician* of April 18, an investigation conducted in New York has led to the discovery of a new plastic material, which is known as 'Caffelite', and industrial plants will come into operation in Brazil this year in which at least part of the excess supply of coffee will be absorbed in the manufacture of Caffelite. The product is said to have useful electric properties at low frequencies. The material is moulded under pressure of one or two tons per square inch, and has a specific gravity of 1·43, that is, about ten per cent higher than wood flour filled phenolic moulding materials of the 'Bakelite' type. The other physical properties are stated to be similar to those of 'Bakelite', and it is claimed that all colours can be produced except white.

Engineering Construction in India

In *Engineering* of April 4 there is an article on a welded water main in Burma which gives an interesting illustration of the growing self-sufficiency of India and Burma from the point of view of engineering construction. Forty-three miles of water main 4 ft. 10 in. in diameter were required for the city of Rangoon. The steel plate was rolled by the Tata Iron and Steel Co. Ltd. at Jamshedpur, and shipped to Rangoon, where the fabrication was effected by Messrs. Braithwaite, Burn and Jessop Construction, Ltd. The main was made in lengths of 25 ft., each length of pipe consisting of three plates in the circumference, the plates as rolled being 62 in. wide by $\frac{7}{16}$ in. thick. After the plates had been bent to one-third of a circle, each set of three was assembled in six rigid rings spaced equally along the length of the pipe and supported on rollers. An automatic carbon-arc welding head, of the 'electronic tornado' type, mounted on a small carriage, was then run along the longitudinal seam at the bottom of the assembly and the pipe rotated for the welding of the two remaining seams in the same position. The inside seams were butt-welded. They were not completely welded from the inside only, a second run on the outside surface of the pipe with an automatic carbon-arc welding-head being required to complete them. The fabrication of this water main necessitated the employment of 500 men, all but ten of whom were native workers. It is noticeable that the time taken for completing the contract was six months shorter than the scheduled time, this being due to the adoption of welding for the construction.

Earthquakes in Spain

Two earthquake shocks caused some slight damage at Jativa, in Valencia, Spain, on May 23. No casualties are reported. Slight earthquake shocks are fairly frequent in southern Spain, which is part of the seismic zone stretching from the Atlantic Ocean at least to Turkey through the Mediterranean.

The Night Sky in June

On or about June 21, the date of the summer solstice, the nights in the latitude of London last barely 7½ hours, if reckoned from sunset to sunrise; but nautical twilight (sun not more than 12° below the horizon) reduces the duration of actual darkness to about 3 hours. Nautical twilight lasts all night throughout the month in Lat. 56° N. Conditions for scanning the night skies this month are therefore much restricted. The moon is full on June 9 at 12·6h. and new on June 24 at 19·4h. Mercury may be seen in the evening twilight this month, greatest elongation of 24° east being reached on June 6. Venus is also an evening star and is in conjunction with Mercury on June 20. Telescopic views will show Mercury as a diminishing crescent and Venus as nearly full in phase. Mars rises in the early morning and is 5° above the eastern horizon soon after 1h. 30m. at the beginning of June and before 0h. 30m. at the end of the month. (All times are given in Universal Time; add 2 hours to convert to Midsummer Time.) The brightness of the planet is increasing; conjunction with the moon occurs on June 16. Saturn is a morning star, low in the east before sunrise; and after mid-June Jupiter comes likewise into view. Saturn is in conjunction with the waning moon on June 21 and Jupiter on the following day.

Portrait of H. E. Armstrong

The first Armstrong Memorial Lecture was delivered by Dr. E. F. Armstrong on February 3. The complete Lecture was published in *Chemistry and Industry* of February 8, and included a striking photograph of "H. E. A." in holiday mood, taken by Mr. Edwin Thompson on board ship between Vancouver and Victoria after the Winnipeg meeting in 1909 of the British Association. Mr. Thompson has a number of photogravure reproductions of this portrait which he is willing to give free of charge to anyone interested; requests should be made to him at Speke Hall Road, Liverpool, 19.

Announcements

At the anniversary meeting of the Linnean Society, held on May 24, the following were elected officers for the year 1941–42: *President*, Dr. E. S. Russell; *Treasurer*, Major F. C. Stern; *Secretaries*, Mr. I. H. Burkill (botany), and Dr. Malcolm Smith (zoology); *New Members of Council*, Dr. B. Barnes, Prof. F. T. Brooks, Mr. J. E. Dandy, Mr. A. C. Gardiner and Mr. Douglas M. Reid.

The Carnegie Corporation of the United States has granted the Society £2,000 for the purpose of photographing the manuscripts and natural history specimens in the collections of Linnæus.

At the annual general meeting of the Royal Sanitary Institute the Earl of Bessborough was elected president in succession to Lord Balfour of Burleigh, whose period of office had expired.

The late Dr. Charles Slater has left £4,000 to the University of Cambridge for teaching or research work in medical science or any science ancillary to medicine at the discretion of the University.

Dr. W. G. Woolnough, geological adviser to the Federal Government of Australia, has retired from the Commonwealth Public Service after thirteen years service and has been succeeded by Dr. R. W. Raggatt, of the Commonwealth Geological Staff.

There will be an exhibition of maps, plans and panoramas of London from the sixteenth century until to-day at the Royal Institute of British Architects, 66 Portland Place, W.1, during the period May 29—June 21, between the hours of 10 a.m. and 6 p.m. (Saturdays, 10 a.m. and 1 p.m.); admission free. The opening of the exhibition will coincide with a lecture on the planning of London, which Mr. W. H. Ansell, president of the Institute, is giving at the Royal Institution on May 29. The exhibits have been drawn mainly from the Institute's own collection; as a precautionary measure, the earlier maps and panoramas will mostly be represented by facsimile copies made by the London Topographical Society.

War has again inflicted severe losses on the University of Louvain. Numerous University buildings were destroyed during hostilities, including the library rebuilt by American generosity and restocked by gifts from nearly every university in the world. Of its 900,000 volumes 15,000 only remain intact, and of its 800 manuscripts only 15 are left.

The Glass Manufacturers' Federation has recently established, for the duration of the War, a Defence Advisory Panel, to advise on scientific, technical and allied problems relating to glass which may arise as the result of contacts between Service or other Government Departments and the Federation. Its members are: Prof. W. E. S. Turner (chairman), Dr. B. P. Dudding, Dr. W. M. Hampton, Dr. H. Moore, Mr. J. B. Murgatroyd, Dr. C. J. Peddle and Dr. E. Seddon. Communications for the Advisory Panel should be addressed to Mr. Geoffrey Marchand, director of the Glass Manufacturers' Federation, Orleans, Latimer Road, New Barnet, Herts.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

Diffuse Reflexion of X-Rays

I WISH to add some remarks concerning the theory of the new effect described by G. D. Preston in his article published under the above title in NATURE of April 19, p. 467. A critical study of the suggestions brought forward by Sir C. V. Raman and Sir William Bragg showed that they cannot be accepted as possible explanations, and some photographs kindly sent to me by Mrs. Lonsdale convinced me that the effect ought to be a consequence of Debye's well-known theory of the influence of thermal vibrations on the scattering of X-rays. As the literature on this subject, although extended, is not satisfactory, I have (in collaboration with Miss K. Sarginson) reconsidered the problem assuming that the scattering power of each single atom is known, and only the influence of the atomic vibrations is to be determined.

Apart from the effect on the intensity of the Laue spots (treated by Debye, Waller and others), there exists a background scattering given by an expression which is not an average over the vibrations (as specific heat is) but depends explicitly on their amplitudes and frequencies. The expressions are rather complicated. In order to simplify them we have assumed that the vectorial waves of atomic vibrations can be approximately replaced by scalar waves. Even then the formula is too complicated to be written down here. It gives a definite intensity distribution of the scattered light for any direction of the incident beam relative to the crystal. It depends, apart from the universal constants, h, k, c, on the wave-length λ of the X-rays and some properties of the atoms and the lattice: the lattice constant, the atomic weight and the function $\omega(\mathbf{q})$ representing the elastic frequencies as a function of the wave vector $\mathbf{q}$. In fact, the intensity is in this approximation a monotonically decreasing function of this $\omega(\mathbf{q})$; therefore the maxima of intensity coincide with the minima of $\omega(\mathbf{q})$.

This result explains most of the features which have been discussed in connexion with the extra spots. The first point is the fact that each extra spot is associated with a Laue spot which it passes when the crystal is rotated, with rapidly changing intensity (increasing for approach to the Laue spot). Indeed, the Laue spots are given by the absolute minima $\omega(2\pi\ ) = 0$ ($\mathbf{h} = (h_1\ h_2\ h_3)$ three integers), which occur only for definite relative positions of crystal and incident ray. If the crystal is rotated the wave vector $\mathbf{q}$, as argument of $\omega(\mathbf{q})$, has to satisfy the relation

$$\mathbf{q} = \mathbf{K}' - \mathbf{K},$$

where $\mathbf{K}, \mathbf{K}'$ are the wave vectors of the incident and scattered beam. If $\mathbf{K}$ is given, $\omega(\mathbf{q})$ is a function of $\mathbf{K}'$ which has relative minima: these are the centres of the extra spots. This result, that the position of the spots is closely connected with the vibrational spectrum of the crystal, is very remarkable. It leads immediately to an understanding of the success of Sir William Bragg's formula. I cannot accept Preston's and Bragg's suggestion that there exist little groups of atoms (such as Bragg's cubes) which scatter independently of the rest of the crystal. This explanation is based on the assumption that the interference effects are due to the *geometry* of the lattice. In fact, these new interferences, which depend on temperature, are due to the *dynamics* of the lattice. One has merely to assume that the forces between the atoms are negligible except for first neighbours; then $\omega(\mathbf{q})$ becomes a periodic function in the reciprocal lattice of the very type from which Bragg derives his formula. We obtain precisely Bragg's formula for a body-centred cubic lattice, and very similar ones for other cubic lattices. But we get in addition a reasonable law for the intensity as a function of temperature which cannot be obtained by any purely geometrical explanation.

We have also studied in detail the behaviour of the extra spots in the neighbourhood of a Laue spot h, with the help of a development in powers of $\varphi - \varphi_h$, the angular displacement of the crystal from the position corresponding to a Laue spot. If the direction of the incident beam is taken as x-axis, and the crystal is rotated about the y-axis, we obtain for the direction cosines ξ, η, ζ ($\xi^2 + \eta^2 + \zeta^2 = 1$) of the scattered beam

$$\begin{cases} \eta - \eta_h = \eta_h \xi_h (\varphi - \varphi_h) \\ \xi - \xi_h = (\zeta_h{}^2 + \xi_h - 1)(\varphi - \varphi_h), \end{cases}$$

where ξ_h, η_h, ζ_h is the direction vector of the Laue spot. These formulæ are purely geometrical and give no information about the physical mechanism. The same holds for the formula giving the angle χ between the extra ray and the Laue ray, for which one obtains

$$\chi = 2 \sin^2 \frac{\theta_h}{2} (\varphi - \varphi_h)$$

where θ_h is the deflexion angle of the Laue spot, which has been derived by several authors (Faxén, Raman, Jauncey, Preston, Lonsdale) on different assumptions.

The physical assumptions of the theory can be tested only by a discussion of the expression obtained for the intensity distribution. We have determined the shape of the spot, that is, the lines of equal intensity; they are ellipses the minor axes of which coincide with the meridian passing through the Laue spot. We have further calculated the maximum and the total intensity of the extra spot; these depend on the neighbouring Laue spot, on the temperature, the wave-length of the X-rays, and the constants of the crystal, chiefly the maximum frequency ω_m of the elastic spectrum, or the corresponding temperature $\theta = h\omega_m/k$. All results are in qualitative agreement with the observations.

MAX BORN.

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May 3.

Free Aryl Radicals in the Fittig and Ullmann Reactions

Hey and Waters[1] have given a valuable review of some organic reactions involving the formation of free radicals in solution. From this and from later work two properties stand out among others as being characteristic of free aryl radicals in solution. One of these is the persistence with which such radicals remove hydrogen from all solvents containing non-aromatic hydrogen, and so become converted to the corresponding aryl hydrogen compounds; and the other is the displacement by them of hydrogen from aromatic liquids to yield biaryls, the substitution occurring invariably *ortho* and *para* to substituents in the benzene ring, irrespective of their nature.

In a series of Ullmann, Fittig and related reactions carried out recently in this laboratory, it was consistently observed that one of the products formed on treating ArX (X = Cl, Br, or I) with sodium or copper was the corresponding aryl hydrogen compound ArH. It seemed probable that this was a result of the formation of free aryl radicals in the reaction, and that ArH was formed from these either by reaction with the diluent (ether), where this was present, or by dismutation when diluent was absent[2].

In order to obtain confirmation of this view, iodobenzene was caused to react with copper bronze in a sealed tube in the presence of an excess of ethyl benzoate, when it was expected that free phenyl radicals if formed would displace hydrogen from the *ortho* and *para* positions in the ethyl benzoate. The product of the reaction was boiled with caustic alkali, and neutral material was separated by ether extraction. On acidification of the alkaline solution a mixture of acids was obtained, in which diphenyl-2-carboxylic acid and diphenyl-4-carboxylic acid have been shown to be present. The latter was easily separated in a pure condition by fractional recrystallization, and the former, which was more difficult to purify, was shown to be present since fluorenone could be isolated from the reaction mixture after treatment with sulphuric acid. No evidence was obtained for the presence of any other components in the mixture.

The isolation of these substances is strong evidence for the formation of free radicals as intermediates in this reaction, and it and allied reactions are under investigation from a similar point of view. The results will be recorded elsewhere.

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R. G. SHUTTLEWORTH.

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Feb. 1.

[1] Hey and Waters, *Chem. Rev.*, 21, 169 (1937).

[2] Cf. Hammett, "Physical Organic Chemistry", McGraw-Hill (1940), p. 144.

Respiration of Leguminous Root Nodules

A PREVIOUS communication from one of us (G. B.[1]) referred to observations on the rate of evolution of respiratory carbon dioxide from leguminous root nodules still attached to the plant. Those observations have been extended and are being published elsewhere. A brief report is presented here of other observations (which will not be continued at present) on detached nodules, made by means of a respirometer designed by one of us (G. F. A.). This apparatus provides concurrent records of oxygen intake and carbon dioxide evolution and is being described in another publication. It is our belief that the only complete figures for the respiratory gaseous exchange of nodules so far published are those of Allison and his collaborators[2,3], though recently Wilson[4] has recorded observations on oxygen intake. Information concerning respiratory events within the nodule will contribute to an increased understanding of the general metabolism of the nodule, including the process of nitrogen fixation.

The observations were made at a temperature of 25° C. on nodules taken mostly from Manchu soya bean plants growing in solution culture. During the determinations the nodules usually were kept moistened with the inorganic nutrient solution in which the plants had been grown. All figures quoted refer to c. mm. oxygen absorbed or carbon dioxide evolved per hour per mgm. dry weight of tissue. In twelve experiments with nodules of various sizes from soya bean plants inoculated with Wisconsin strain No. 505 of the nodule organism, values ranging from 2·31 to 6·25 were obtained for oxygen intake. Using nodules from field-grown soya bean plants, Allison *et al.*[2], at 28° C., obtained lower values for oxygen intake in air (range 0·76–2·05), while Wilson[4] reports a value of 1·53 for nodules from plants infected with strain 505. Allison *et al.* observed that the respiratory quotient was well above unity for nodules respiring in air, the range for soya bean nodules being 1·23–2·00. Partly because of this type of result they concluded that partially anærobic conditions prevail within nodule tissues. In our material also the respiratory quotient was usually greater than unity (range 1–1·25). For detached younger parts of the roots of the same soya bean plants, values of 1·70–2·17 were obtained for oxygen absorption, with quotients very close to unity. The rate of respiration of the roots was thus inferior to that of the nodules, whereas Allison *et al.*[3] concluded that in their material root and nodule respiration were of the same order. Wilson[4], on the other hand, observed root respiration to be considerably in excess of nodule respiration. It thus appears that the intensity of respiration within leguminous nodules and roots is liable to vary in material from different sources.

Contrary to the experience of Allison *et al.*[2], in our material of soya bean nodules no definite tendency was detected for the respiratory quotient to be higher in larger nodules than in smaller ones, though observations on this point were not extensive. Nodules from plants infected with an ineffective strain of the nodule organism (No. 507) showed much lower rates of respiration (oxygen absorption 0·7), though the respiratory quotient was similar to that characterizing nodules in which normal fixation was proceeding. For pea (*Pisum sativum*) nodules figures of 1·89–3·24 were obtained for oxygen intake, the respiratory quotients ranging from 1·05 to 1·25. In all these observations the respiration measured is, of course, due partly to the plant tissues of the nodule as well as to the bacteria.

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G. BOND.

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April 29.

[1] Bond, NATURE, 144, 906 (1939).

[2] Allison, Ludwig, Hoover and Minor, *Bot. Gaz.*, 101, 513 (1940).

[3] Allison, Ludwig, Minor and Hoover, *Bot. Gaz.*, 101, 534 (1940).

[4] Wilson, "Biochemistry of Symbiotic Nitrogen Fixation" (1940).

Publication of New Species

ONE of the inevitable results of the War is a reduction in the output of pure scientific literature. This enforced breathing-space seems an excellent opportunity for scientific workers in general, but systematic zoologists in particular, to assail the problem of the scattering of the literature.

In year 1935	Number of publications other than books	Number of journals used	Number of authors	Authors publishing single paper during the year	Authors who publish more than one paper and confine publication to one journal only	Journals publishing one paper only devoted to the one group of animals in question	Journals entirely devoted to one group in question	Number of new species described in the year	Number of journals in which these new species are described	New species described in purely medical journals
Protozoa*	940	263	605	441	48	150	3	549	83	9
Mollusca	1117	376	698	528	56	184	7	1437	139	Not checked; probably none
Helminths (including medical literature)	1400 (392 medical)	451 (166 medical)	1191	1037	55	287	3	776	112	34
Siphonaptera (Insecta)	19	17	15	14	1	15	0	15	5	1
Aves	1662	388	1043	769	93	203	39	230†	39	Not checked; probably none

* These groups are not comparable as entities, and include fossil species.

† Sub-species as well as species.

Probably only systematists are aware of the extent of this scattering. The output is considerable (Salt points out that 10,000 new species of insects are described every year), but nevertheless a disproportionate amount of time is spent 'grubbing' in the library. Who has not groaned over obscure periodicals, such as the *Acta Univ. Latv.*, the *Est. de Sci. Habana* or the perennial *Igakkai Zasshi* ?

The table above shows an analysis of the literature of a twelve-months' period chosen at random, and relating to five groups of animals, also chosen at random. No comment is really necessary, but one or two points may be emphasized :

(*a*) The number of journals which, during the year, print only *a single* paper dealing with any one of the groups in question ;

(*b*) The low percentage (20 per cent) of authors publishing more than one paper during the year, who confine these to one journal ;

(*c*) The scattering of descriptions of 776 new species of helminths through 112 journals.

The causes of this literary diaspora are diverse and numerous. Authors, for example, may desire to publish several papers simultaneously, or obtain plates to illustrate them all, or to increase the circle of their readers, or to achieve priority by rapid publication in some modest journal without a waiting list. Financial considerations, on the other hand, prohibit the production of many journals devoted to single groups, except in cases of special popularity, such as we find in the class Aves. Institutes which publish their own journals must include widely divergent contributions. Editors, with an eye to the standard of their publication, its circulation and limited resources, look upon short papers with favour and encourage 'variety'. There are also geographical, nationalistic and linguistic groupings. Nevertheless, however diverse the legitimate and non-legitimate reasons for the scattering may be, the fundamental underlying cause is the total lack of any real system associated with the publication of scientific literature.

Perhaps it is over-sanguine to dream of international co-operation at the present moment, but even co-operation on a small scale between editors in any one country might lay the foundation for more ambitious and far-reaching schemes.

A little judicious exchange would eliminate those cases of journals printing, for example, one helminthological paper a year, and render impossible specific zoological descriptions of new species appearing exclusively, for example, in *Arch. Experimental Medicine*. For institutions, a more widespread application of the system of publication of the American Museum might also be advocated.

We hear much from politicians on the subject of post-war reconstruction. Surely the systematic zoologists will seize this unequalled opportunity for turning the present loss of time into future gain ?

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Decipherment of Charred Documents

THE large number of hand-written documents, such as deeds, accounts and ledgers, which have recently been damaged or destroyed by fire has inevitably directed attention to methods of deciphering charred documents, and the description of a simple photographic method recently found successful in these laboratories may be of interest. The documents on which most of our experiments have been carried out were burnt completely black, but were fairly resistant to handling and showed traces of the writing in relief on the surface. No results were obtained by ordinary photographic copying methods with oblique lighting, with infra-red or ultra-violet radiations, or by the chloral hydrate method described by Messrs. Taylor and Walls of the Metropolitan Police Laboratory at Hendon[1].

The method depends on exaggerating photographically the difference between the specular reflectivity of the remains of the plain paper and of the ink. Essentially, the charred paper surface can be regarded as a mirror the surface of which can be made to reflect an intense source of light close to the camera lens and on which the original writing stands out as a dark shadow, presumably due to the disturbance of the paper fibres by the pen and to the presence of some residual salts from the ink. This shadow is photographed by the use of a high contrast blue-sensitive plate such as the Kodak *B* 5.

In practice, it is first necessary to render the charred sheet absolutely flat. With the more robust of the specimens, this is easily possible in a pressure printing frame. If the pressure is applied evenly and fairly slowly the sheet does not tend to crack up. It has been found satisfactory to press more fragile specimens gently on to the damp surface of a gelatin-coated glass sheet, such as a fixed-out and washed photographic plate, and then to apply pressure in the frame.

The most suitable lighting has been found to be a small arc lamp close to the camera with a lens so arranged that it throws a narrow beam of light on to the copy. This gives the required illumination and, in conjunction with a long-focus lens on the camera, the optimum type of reflexion into the lens from the surface of the document. It is well known that differentiation between specularly and diffusely reflected light can be increased by the use of polarizing screens over the camera lens, but so far this additional step has not been found necessary for successful deciphering of the documents we have examined.

No claims are made for the infallibility of the method described, and, in fact, it is probably practical only with a fairly limited number of combinations of ink and paper, but, as it has been found to work excellently in some cases where all the methods described in the literature have failed, we feel that its publication may be of use to other workers.

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[1] NATURE, 147, 417 (1941).

"The Man of Science as Aristocrat"

LIEUT.-COLONEL MOORE-BRABAZON has fallen into a common error of thought when he says that a politician who ensures a milk supply deserves more of his fellow men than does the inventor of the quantum theory[1]. The boy who posts a lighted squib in a pillar box commits the same offence whether the pillar box is empty or is filled with an unusually important mail. The fact that an action does not seem to the majority to be of immediate consequence is no guide to its importance. Colonel Moore-Brabazon's hypothetical politician will be deserving of the severest censure if he does not ensure the necessary milk supply, provided always that he is aware that our state of mechanical and scientific development is such as to make it possible; he deserves no credit for doing what is simply his job.

Our difficulties lie in the provision of such gifted public servants. Many of those we now have, by their lack of a scientific background, are unaware that the solutions of their problems exist, and in some instances there is even a suspicion that the existence of the problem itself goes unnoticed. The imperative need for men of science with a responsibility in public affairs, in a social system which has changed out of recognition in a period measured in months, is not at all appreciated.

It is true that, "in the narrow world of science" the inventor of the quantum theory gets more attention than the average run of politicians do; but it must also be pointed out that the man of science who enters the public service is left in no doubt of the inferiority of his position compared with that of his lay colleagues. In consequence of this, cases are known of young men with the foundation stone of scientific knowledge laid at their universities who have seen the financial folly of building a superstructure of experience thereon, and have deliberately concealed their degrees in science in order to taste the fleshpots of an 'administrative' post which could be filled by an intelligent clerk. Such a man is a waste of material, since it is only by the practice of science over a period of years that he gains a knowledge which is likely to be useful to his fellow men. By that time an attempt to 'come out of his shell' is usually out of the question on account of his age and lack of 'administrative' experience, for he will naturally prefer to remain in his shell rather than enter a new field as a junior.

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[1] NATURE, 147, 544 (1941).

Reservation of Librarians

I SHOULD like to direct attention to a serious defect in the Schedule of Reserved Occupations just issued by the Ministry of Labour. While the librarians of newspapers, periodicals or news agencies are reserved at the age of thirty-five, the librarian of a university, public or research institution library is not reserved at all. General clerical staffs of universities and municipalities are also reserved at thirty-five, and it would therefore appear that the importance of what to every scientific worker is a vital tool—a well-selected and organized library under competent direction—is not realized by the Ministry.

NATURE has from time to time given space to notes about the pioneer work of the Science and Technology Department of the Sheffield City Libraries, particularly in regard to the organization of the interchange of technical information between research libraries in the Sheffield area. This Library may be used as an illustration of the unwisdom of the Ministry's decision. Since the War began, the Science and Technology Library has issued more than forty bibliographies dealing with specialized aspects of steel making and steel treatment. Requests for copies of these bibliographies have been received from scores of important industrial establishments, both at home and overseas, which maintain research staffs, and copies of some of them are being prepared for distribution by the Ministry of Supply. It would seem reasonable to suggest that the librarian of a library of this type, which can be paralleled by similar special public libraries in other great cities, should be held to contribute as much to the promotion of the War as a routine clerk in other departments of the municipal service.

J. HAWNT,
Chairman of the Libraries, Art Galleries
and Museums Committee, Sheffield.

We believe that the principal purpose of the Schedule was to obtain postponement of the calling-up of whole groups of people. In addition, an employer may apply for the deferment of the calling-up of an individual who is personally indispensable, and each such case is considered on its individual merits. In view of the high proportion of librarians for whom reservation will no doubt be justly claimed, it would seem that qualification of the Schedule definition is desirable.—Editors of "NATURE."

RESEARCH ITEMS

Breeding-Place of Ross's Goose

Ross's goose, *Chen rossi*, has many associations with the Hudson's Bay Company. One of its officers recorded it in 1795, in 1861 it was named after the officer at Fort Resolution, and now in 1940 the support of the Company and the energy of its representatives have solved the mystery of its breeding-place (P. A. Taverner, *Canadian Field-Naturalist*, 54, 127). This small goose, scarcely larger than a mallard duck, used to be abundant about Lake Athabasca and Great Slave Lake, where so many were killed and salted for winter food that fears have been expressed for its survival. But until now nothing has been known about its breeding haunts, and the only egg in existence was one laid in captivity. In 1940 the Hudson's Bay Company authorized an expedition for the express purpose of solving the problem, and guided by promising native reports the explorers, two managers of the Company's posts and four Eskimos with a canoe on dog-sled, pushed up the Perry River which flows into Queen Maud Gulf close to longitude 102° West. Up a tributary of the Perry they reached an unnamed lake—the country is unexplored and unmapped—where large numbers of Ross's geese were seen. The lake was studded with two or three hundred islets, and on these the white geese were nesting, looking at a distance like ptarmigan in winter plumage. The nests, sometimes within three feet of each other, were about a foot across, lined with down, and contained from two to six creamy-white eggs. Natives reported that the chief breeding-grounds were on an island in a larger lake about six miles away, and they reckoned that about two thousand would be nesting there.

Termite Investigations in Australia

Two species of mound-building termites, namely, *Eutermes exitiosus* Hill and *Coptotermes lacteus* (Froggi) have been the subjects of several investigations carried out under the ægis of the Council for Scientific and Industrial Research for Australia. Two papers, by F. J. Gay and J. Greaves, which deal more especially with the last-named species, have recently been published (*J. Coun. Sci. Ind. Res.*, 13, No. 2; 1940). The first paper is concerned with analyses of the populations of two colonies of *C. lacteus*, and is complementary to an earlier paper dealing with the population of Eutermes colonies. Coptotermes, it may be added, is the genus responsible for most of the damage incurred by termites in Australia. The estimated populations of two colonies of the species *C. lacteus* amounted to 600,000 and 1,100,000 individuals respectively, with a caste ratio of 86–92 per cent of workers, 6–7·5 per cent of reproductive nymphs and 2–3 per cent of soldiers. Compared with *E. exitiosus* the proportion of soldiers is much lower in *C. lacteus*, whose whole population is also rather less. In a second paper in the same issue of the journal already named, the authors discuss the subterranean foraging galleries which radiate from the central mound or nest of *C. lacteus*. Some fifteen main galleries were found to branch in a manner that causes them to extend over an area of approximately 1½ acres. These galleries enable the termites to reach logs or pieces of dead wood, which provides their staple food. Such logs may be up to 50 yards distant from the central mound. In each of two other mounds, located in a different type of habitat, the foraging galleries were more than thirty to a nest. While these galleries may lead with reasonable directness to neighbouring logs, their detailed meanderings en route indicate that such passages rarely point in the actual direction of the logs with which they become ultimately connected. It is concluded that the termites in question do not possess any mysterious sense of direction which some observers may be inclined to attribute to them.

British Water Bugs

We have recently received Scientific Publication, No. 4, of the Freshwater Biological Association of the British Empire. The work in question is entitled "A Key to the British Water Bugs", 1941, and is written by T. T. Macan. In the small compass of thirty-six pages is included sufficient information and illustrations to enable all British aquatic Hemiptera-Heteroptera, excluding the Corixidæ, to be readily identified. Notes on the biology and distribution of the various species are included, together with a list of the more important original papers bearing upon the subject. For the Corixidæ the reader is referred to a previous publication issued by the Association. It is noteworthy that the last comprehensive work on British Heteroptera, which included the aquatic forms, was that by Butler, published in 1923. Since that time recent work has made this volume somewhat out of date in so far as the grouping of the members of Notonecta are concerned, while the addition of a species of Hydrometra and of two species of Microvelia to the British fauna have to be noted. These and other features are dealt with in Dr. Macan's brochure, which is obtainable from the Association at Wray Castle, Ambleside, Westmorland, price 1*s*. 6*d*.

Microsporophylls of Caytonia

A reinvestigation by Prof. T. M. Harris (*Ann. Bot.*, N.S., 5, No. 17; Jan. 1941) of the microsporophylls of Caytonia greatly strengthens the evidence for associating the Caytoniales with the Pteridosperms rather than with the Angiosperms. In construction and mode of dehiscence the Caytonanthus synangium is wholly unlike any flowering plant anther, while the leaf-like branching and dorsiventral structure of the whole sporophyll is equally remote in morphology from any Angiosperm stamen. The synangia of some fossil Marattiaceæ and Pteridosperms, however, show much closer resemblances to Caytonanthus which also shares with some Mesozoic plants of Pteridospermous affinity the winged pollen grains which mark it off from all known Angiosperms. A critical re-examination of the pollen grains leads to the recognition of another species of Caytonanthus, *C. oncodes*, which differs from *C. Arberi* in the dimensions of the pollen grains. The former is referred to *Caytonia Sewardi* which it pollinates while the pollen in the micropyles of seeds of *Caytonia Nathorsti* is referred to *C. Arberi*.

Banana Leaf Disease

RECOGNITION of the fact that the leaf spot disease of bananas (*Cercospora musæ* Zimm.) in Jamaica is likely to remain, has directed attention to the need for securing control at minimum cost. Spraying with copper-containing fungicides has been found to give good control, but under Jamaica conditions is liable to prove expensive, tedious and, on much of the land under cultivation, difficult. It is therefore necessary that simple and economic means of securing adequate control should be sought. Recent investigations by R. Leach (Bull. 26, Dept. Sci. and Agr., Jamaica, 1941) have been undertaken with this end in view. As elsewhere the heart leaves are most subject to infection. A curious feature noted by Leach, as also by other investigators, is that while spraying gives good control, the waxy heart leaves are, nevertheless, seldom adequately covered with spray. The view is put forward that spraying attains control for the most part by interfering with the production of Cercospora spores and by affecting the germination of spores which may reach the unsprayed heart leaf —a conclusion which may not receive general complete acceptance. Shade has again been found to be an important factor in reducing spore production in that it also reduces dew formation. An indication has also been obtained that appreciable damage from secondary infection on older leaves occurs only spasmodically, under conditions as yet undetermined although apparently connected with a marked fluctuation in soil moisture conditions. The general conclusion is reached that the nature of leaf spot disease is essentially cumulative.

Inheritance of Pits in the Ears

PITS in the ears which sometimes simulate holes pierced for ear-rings are shown to be inherited in man by H. W. Edwards and C. E. Keeler (*J. Hered.*, 31, 507–510; 1941). These pits on both lateral and medial surface of the lobe of the ear do not usually form a channel through the ear, but appear similar to old, healed, ear-ring puncture marks. The character is inherited in two families as an irregular dominant, with indications of other factors which modify the expression.

Topography of the Red Sea

A REPORT issued by the Egyptian Biological Station at Ghardaqa contains an account of its preliminary exploration of the Red Sea, arranged under C. Crossland in H.E.M.S. *Mabahith*, which was fitted with sonic sounding. The cruises included six traverses across the northern part of the Red Sea, a special investigation of the entrance to the Gulf of Aqaba and two sections along its length and five across. The Gulf of Suez is a shallow shelf at 30–40 fm., while Aqaba is separated by a sill at 140 fm. Within there is a depth of more than 1,000 fm.; this occurs on its east side where the slope is practically a precipice, ending in the cliffs of mountains equally high above sea-level. For charting, adjustments of the echo soundings have to be made, for the echo comes from the nearest land face, so that in front of a precipice it will be at a considerable angle to the vertical. In the Red Sea the long trough more than 1,000 fm. deep proved to be a narrow valley, a regular rift feature. The descent to this is by a series of steps, some of which on the Arabian side are reached by precipitous falls of 400–500 fm. Indeed the features described by Wharton for Masamarhu seem topographically to be quite general in the Red Sea off coasts and islands; there were also found many pinnacle reefs reaching sea-level. Sedimentation was found to be very small in all parts, so that the slopes were never masked.

Source of Copper in Ore Deposits

C. H. WHITE has recently discussed the concentration, distribution, and origin of copper ores in the earth's crust (*Economic Geol.*, 36, 1; 1941). Although copper occurs in traces throughout the earth's crust, commercial deposits of copper ores occur only where the crust has been fractured by faults, fissures or shear. The ores are found in rocks of all types, sedimentary, igneous and metamorphic, and their deposition has especially followed periods of profound crustal deformation. Careful study has shown that deposits long thought to be magmatic segregations—like those of Sudbury—are in reality metasomatic replacements, genuine magmatic segregations, if any, being small and unimportant. It is known from observation that sulphides ascending from the depths are capable of replacing practically every other mineral in their path if conditions are favourable. Igneous intrusions do not occur in all copper districts. Where they do occur the usual sequence is (*a*) acid magma; (*b*) basic magma; (*c*) mineralization by copper sulphides. It is suggested that as the earth cooled to temperatures permitting chemical union of the atoms, the interaction of physical and chemical forces, notably gravity and the combination of the elements in the order of the heats of formation of their compounds, led to the concentration of copper and sulphur and of other similarly less chemically active heavy metals and their associated anions, to a zone underlying the silicate crust, where they remained until released by sub-crustal fractures. If fractures reach only to the level where acid magma is generated, granitic magma ascends; if they tap the basic zone, basaltic magma ascends; and only if they reach through to the sulphide zone do ores ascend. A similar hypothesis, based quite independently on the difference between the atomic weight of ore-lead and that of rock-lead has been proposed for lead ores by Holmes (*Econ. Geol.*, 32, 782; 1932: 33, 829; 1938).

Coupling of Diazonium Salts

A kinetic study of the coupling of diazonium salts with phenols made by Conant and Peterson in 1930 indicated that the measured rate was governed by an acid-base equilibrium in one or other of the reactants:

$$(1)\quad ArN_2^+ + OH^- \rightleftharpoons ArN_2OH$$
$$(2)\quad ArOH \rightleftharpoons ArO^- + H^+.$$

The conclusion was reached that the reaction was between undissociated phenol and undissociated diazo-hydroxide, the effect of alkali being to promote the reaction by increasing the amount of diazo-hydroxide. R. Wistar and P. D. Bartlett (*J. Amer. Chem. Soc.*, 63, 413; 1941) have studied the coupling with aromatic amines, reaction (2) being replaced by

$$(3)\quad ArNH_2 + H^+ \rightleftharpoons ArNH_3^+.$$

In this case the acid-base equilibrium reaches 50 per cent in the region of acidity corresponding with maximum velocity. There are four possibilities for the reaction: (1) diazo-hydroxide couples with the ammonium ion, (ii) diazonium ion couples with free amine, (iii) diazonium ion couples with ammonium ion, (iv) diazo-hydroxide couples with free amine. A kinetic study of the influence of *p*H on the coupling of 1-naphthylamine-4-sulphonic acid and diazotized sulphanilic acid and of 1-naphthyl-amine-8-sulphonic acid and diazotized aniline was consistent with two mechanisms, but only one of these was in harmony with the facts regarding the activating and directive influence of aromatic substituents on the coupling reaction. It was thus shown that the active components in the coupling reaction are the diazonium cation and the free amine or phenoxide ion. C. R. Hauser and D. S. Breslow (*ibid.*, 418) also reach the conclusion that the diazonium ion is involved rather than the diazohydroxide, and show that this is in agreement with accepted electronic theories, the ion being an electron-accepting component and representable in two resonance forms.

Determination of Zinc in Magnesium Alloys and Zinc Alloys

E. Q. Laws discussed the above at a meeting of the Society of Public Analysts and other Analytical Chemists held on February 5. The precipitation of zinc as sulphide from a buffered solution of formic acid and ammonium formate, investigated by Fales and Ware, is shown to afford a rapid and accurate means of separating zinc from a large excess of magnesium, aluminium, nickel, manganese and iron. Details were given of the application of the method to the determination of zinc (*a*) in synthetic mixtures, (*b*) in magnesium alloys containing 5–10 per cent of aluminium, 0·7–3 per cent of zinc and 0·5–1 per cent of iron, and (*c*) to copper-nickel-zinc alloys containing 20 per cent of zinc, 45 per cent of nickel, 0·5 per cent of manganese, 1 per cent of iron and the rest copper. With (*b*) it was found necessary to redissolve and reprecipitate the zinc sulphide; with (*c*) the copper was first removed electrolytically and a single precipitation of the zinc sufficed.

Origin of Transient Ionic Clouds

In a theoretical note, P. M. S. Blackett and A. C. B. Lovell (*Proc. Roy. Soc.*, A, 177, 183; 1940) suggest that the origin of some of the transient ionic clouds, generally assumed to be responsible for the low-level sporadic radio reflexions, may be due to large cosmic ray showers. Cascade cosmic ray showers of sufficient energy to produce some of these radio reflexions have been recorded, but the data are inadequate for a test of the theory. More suitable results could be got from the frequency-size distribution of the radio echoes observed from a horizontal or vertically directed beam.

X-Ray Crystallography and Chemistry of the Steroids

A comprehensive survey of the X-ray crystallography of some eighty sterol derivatives belonging mainly to the cholesterol and ergosterol series but including also calciferol and other photo-derivatives of ergosterol and some higher plant and animal sterols has been made by J. D. Bernal, D. Crowfoot and I. Fankuchen (*Phil. Trans. Roy. Soc.*, A, 239, 135; 1940). The crystallographic measurements are discussed in their bearing on specific chemical problems of characterization and identification, determination of molecular weight, the stereochemistry of the carbon skeleton, the effect of substituents on the crystallography of the sterols, a comparison of the crystallography of different sterols—monohydroxy compounds and the structure of calciferol. The survey illustrated very plainly the limitations of preliminary crystallographic study as a source of chemical information. Even in matters of straight identification, there may be difficulties where impure preparations consisting largely of mixed crystals or where polymorphic modifications are concerned. Exact X-ray analysis of carefully selected substances is proposed.

Stellar Colour Temperatures

It is now recognized that the continuous radiation of the stars cannot be represented even approximately by Planck curves over all observable wavelengths. The recent discovery that negative ions of hydrogen may make an important contribution to the opacity of stellar atmospheres leads R. Wildt (*Astrophys. J.*, 93, 47; 1941) to inquire whether the observed energy distribution curves can be reproduced from theoretical considerations, knowing the absorption coefficients of H and H^-, and assuming the absorbing atmosphere to consist of these particles only. He finds that this can be done tolerably well for early-type (*A*0 to *F*0) stars. For later spectral types, however, the predicted colour temperatures fall below the effective temperatures, whereas the observed values are much higher. Moreover, no addition of absorbing metallic atoms to the hypothetical atmosphere can improve matters, since metallic absorption in a late-type star rises steeply towards the violet, and therefore lowers the colour temperature still further. Thus it seems that yet another attempt to reconcile theoretical colour temperatures with observed values has failed. At present it looks as if further attempts will also fail unless they embody some hitherto unknown mechanism which produces an absorption coefficient decreasing from the near infra-red towards the violet.

Systematic Corrections to Proper Motions

W. M. Smart has discussed (*Mon. Not. Roy. Astro. Soc.*, 101, 1) the "Systematic Corrections to the Proper Motions of the General Catalogue" more fully and accurately than previous investigators have done. It is pointed out that in the discussion undertaken by R. E. Wilson and H. Raymond (*Astrophys. J.*, 47, 49; 1938) the elements of the solar motion, the precessional corrections and the constants of galatic rotation were derived from two solutions, one based on Schönfeld's equations in equatorial co-ordinates, and the second in galactic co-ordinates. As Miss Emma Williams has shown, however, the equatorial equations are incomplete so far as the rotational effect is concerned, because the double-wave term which depends upon Oort's constant, *A*, is omitted. In addition, some small adjustments were necessary owing to a misinterpretation of Schönfeld's notation and the omission of a factor. Smart points out also that the numerical formulæ which Wilson and Raymond have derived (*Astrophys., J.*, 47, 57; 1937) for the systematic corrections to the proper-motion components are incomplete and do not fully satisfy the requirements of investigations dealing with small proper motions. In the present paper Smart applies the best available systematic corrections and derives the equations of condition for the elements mentioned above in literal form. Tables I and II supply the values of the corrections $\Delta\mu_\alpha \cos \delta$ and $\Delta\mu_\delta$, the unit being 0·01″ per century. Literal equations are also given when the solution is effected in galactic co-ordinates.

DEVELOPMENT OF THE FRONTAL BONES OF THE RAINBOW TROUT

By J. A. Moy-Thomas,

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THE causes responsible for the development of the dermal bones of the skull in fishes have been the basis of much speculation by morphologists and palæontologists. Although this problem has been a popular one with workers in recent years, almost all the theories which have been formulated have been deduced either from purely morphological evidence or from abnormalities found in Nature, and so far as I am aware, the only experimental work of importance is that of Tatarko[1] on the opercular apparatus of the carp. His experiments, however, deal exclusively with the regeneration of bones and not with their development.

The experiments which are described below were undertaken by me with the object of throwing light on some of the more outstanding problems connected with the formation of the frontal bones in the trout. The method employed was a modification of that described by Hoadley[2] for Fundulus, in which pieces of embryos were removed through the egg-membrane by pricking with a glass needle and squeezing out the desired part by means of a small glass ring on a glass rod. Trout proved particularly satisfactory material for this work as they are very easy to keep alive, and do not require feeding until the yolk sac is absorbed, at which stage they are nearly fully developed. If necessary, however, they will readily feed and flourish on a little pounded liver. The trout used in the experiments were rainbow trout supplied by the Midland Fisheries, Nailsworth, Gloucester.

On theoretical grounds it has been suggested that the sense organs of the lateral line canal system of the head are important agents in stimulating bone formation in their vicinity. This view is based very largely on observations by Pehrson[3] on the development of the skull of Amia. Pehrson showed that those dermal bones which in the adult are connected with the lateral line canals start their development as aggregations of osteoblasts around certain of the sense organs of this system. The osteoblasts then give rise to small rudiments of bone around the sense organs, which may or may not in later development fuse with adjacent rudiments to form the adult bones. From this early association of the lateral line sense organs and certain dermal bones it has been argued that the former are the cause of the development of the latter. Many writers have attributed so much importance to this assumption that they have based their ideas of bone 'homology' to a great extent on it.

The experiments which I have carried out show that no such causal relationship exists. The rudiments of the lateral line canal system were removed from one side of the roof of the skull of an early trout embryo, shortly after the formation of the eyes. At this early stage no traces of sense organs or frontal can be distinguished in this region. The result of such an operation was to produce a fish in which the frontals were developed on both the right and left sides, but the frontal on the operated side, where there were no sense organs in its immediate neighbourhood, was rather less advanced in its development than that of the other side.

Similarly in fishes in which two or three sense organs and a piece of the canal are removed from the middle of the frontal region, the frontal develops normally, but the bony 'gutter' usually formed round the canal is absent in the region where the organs have been extirpated.

These two sets of experiments demonstrate conclusively that the actual origin of the frontals during development is due to some cause other than the presence of the sense organs of the lateral line canal. The lateral line itself appears only to be capable of stimulating bone formation in its own close vicinity, but not of initiating the appearance of a frontal.

Two further sets of experiments were carried out to demonstrate the influence of the brain on the development of the frontals. In one lot the greater part of the brain, namely, the forebrain, optic lobes and most of the cerebellum, was extirpated at an early stage, when the neurocranial part of the chondrocranium consisted only of trabeculæ, parachordals and the rudiments of the cartilaginous auditory capsules. The skull resulting from this brain removal consisted of fairly normal olfactory and auditory regions, but the intervening taenia marginales were fused into a continuous median rod leaving no cerebral cavity anteriorly to the auditory capsules. Nevertheless the frontals developed as paired bones. Their position relative to the taenia marginales and other cartilages in the neighbourhood, in which the frontals usually develop, was as nearly normal as possible. They were also connected with their appropriate lateral line canals, except of course in those cases where the latter had been removed. The operation of removing the brain obviously greatly reduces the quantity of tissue between the eyes, and the lateral line canals and the rudiments of the frontals lie relatively much closer together on top of the head. Thus the frontals have a very much smaller area to cover than normally, and it can be seen that the ossification around the sense-organs and canals is thicker and more advanced than in an unoperated animal of similar age.

These experiments demonstrate that the paired nature and origin of the frontals is not related in any way to the underlying brain. It is interesting to compare this artificially produced condition with that in microcephalic and anencephalic skulls in man. In these monstrosities the full complement of dermal bones is formed, but the brain-case is greatly reduced in size.

The second set of experiments consisted in removing the eye on one side of the embryo a short time after its appearance. As development proceeded the optic lobe of the unoperated side remained small, whereas that of the operated side, which innervated the remaining eye, increased in size at the normal rate of development. The greater part of the frontals usually cover the optic lobes, and the bones of each side meet each other between the right and left optic lobes almost precisely in the middle line. However, in the operated individuals in which the optic lobes are unequal this relation between frontals and the brain no longer exists, each frontal growing towards the middle line of the head at more or less its normal rate. The frontal of the unoperated side thus comes to extend beyond the middle line of the brain over the optic lobe of the other side. From these experiments, therefore, it can be concluded that the median suture of the frontals is independent of the underlying brain. Although these results are such as would on general grounds be expected, they are opposed to the interpretation put by Troitsky[4] on his experiments with the dog's skull.

Although the experiments here described throw no positive light on the nature of the processes governing the initiation of ossification at certain definite places in a developing skull, they do much to dispose of some commonly held but erroneous views, especially those concerned with the lateral line canal. The repercussion of these conclusions on the method of homologizing dermal bones appears to me to be very important to morphologists generally, and will be discussed at length when this work is published in full.

[1] *Zool. Jahrb. Abt. alg. Zool.*, **53**, 461 (1934).

[2] *J. Exp. Zool.*, **52**, 7 (1928).

[3] *Acta Zoologica*, **3**, 1 (1922).

[4] *Z. Morph. Anthrop.*, **30**, 504 (1932).

PSYCHOLOGICAL ASPECTS OF COLOUR MEASUREMENT

By Dr. H. J. Eysenck
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COLOUR STANDARDIZATION has two aspects which are of equal importance—the physicochemical and the psychological. The work of Ostwald[1] has been severely criticized in NATURE by J. Guild with regard to its physico-chemical foundations[2]; with Ostwald's psychological and æsthetic considerations Guild refuses to deal, because "they have no relevance to colour measurement" (p. 272). To the psychologist, however, it is just these considerations which are of the greatest interest, particularly as the great success which the Ostwald system has had commercially both in Great Britain and in Germany indicates that the needs which Ostwald attempted to meet are very real needs among those who have to deal professionally with colours, coloured papers and the like. An examination of the claims advanced on behalf of Ostwald's "Colour-Science" in the psychological sphere may therefore not be out of place, especially at the present moment, when a *psychological* standardization, such as Ostwald attempted, may easily be of great importance in the practice of camouflage, where, as in pictorial art, human perception and not physical apparatus is the ultimate arbiter of colour and brightness equalities and differences.

The two main claims made by Ostwald with regard to his system are (*a*) that his eight standard greys, the differences between which are based on the Weber–Fechner law, are equidistant psychologically, and (*b*) that the twenty-four colours which go to make up his colour-circle are also psychologically equidistant. Several further claims are made with regard to the æsthetic qualities of certain relations obtaining between both the greys and the colours, the two main of which are (*c*) that triads made up of three greys the differences between which are equal according to his system are especially pleasing, and (*d*) that diads made up of two colours which are eight steps apart on his colour-circle are also especially pleasing.

These four claims were submitted to experimental tests, and the results are reported below. The materials used were the coloured papers produced by the W. Ostwald Farben G.M.B.H., and wherever possible the results were checked up with the dyed fabrics given in his book. (The papers are produced very carefully according to Ostwald's own formulæ, and give, as he himself acknowledges, a very good approximation to the colours intended. It would, of course, be preferable in some ways to work with coloured lights, but Ostwald is very emphatic in his assertion that his laws apply only to *reflected* light.)

(*a*) Ostwald's first claim was tested in two ways. (1) Twelve subjects were given seven cards on each of which two consecutive Ostwald greys were affixed, and asked to judge the amount of 'difference' of the two greys on each card as compared to the others by the method of paired comparison. The following results were reached:

Greys	Judged 'Larger than'	Judged 'Smaller than'	Judged 'Equal to'
a/c	93 per cent	0 per cent	7 per cent
c/e	38	13	49
e/g	37	18	45
g/i	33	17	50
i/l	33	18	49
l/n	3	85	12
n/p	0	86	14

The second test was carried out by means of a method suggested by Barnhart[3], and particularly well adapted to questions of this kind. (2) Ten subjects were asked to arrange rectangular pieces of paper, each cut from one of the eight greys, on specially prepared sectional paper in such a way that the distance on the paper was to be taken as an indication of the difference in brightness between them. The average distance for all the greys being put at 1·00, the average distances between any two consecutive greys were: $a/c = 1\cdot 8$; $c/e = 1\cdot 2$; $e/g = 1\cdot 0$; $g/i = 0\cdot 9$; $i/l = 1\cdot 0$; $l/n = 0\cdot 6$; $n/p = 0\cdot 5$. Thus the two methods give much the same results: while the greys in the middle are more or less equidistant, grey *a* is too far away from grey *c*, and the last three greys (*l*, *n*, and *p*) are much too close together. This result is not unexpected in view of the results reported by König[4], Burkamp[5] and others, with regard to the limited applicability of the Weber–Fechner law to brightness differences.

(*b*) A similar method was adopted in testing Ostwald's claim with regard to the colour-circle. Two concentric circles, of diameters 50 and 52 inches respectively, were drawn on white cardboard, and the ring between them divided into 48 equal parts. From the 24 Ostwald colours pieces were then cut out in the exact shape of the ring-segments, and laid on the ring in such a way that each piece was followed by a blank segment. Twelve subjects were told that the average difference between one colour and the next was represented by one blank space on the chart, and that if anywhere they noted that two colours were either too close together, or too far apart to be fairly represented by a distance of one space, they should change the distance until it represented as accurately as possible their opinion of the difference. The following table gives the average amount of change advocated, indicating both direction and size of the change. A + sign indicates that on Ostwald's circle the distance between the two colours is too small, and should be increased by the amount shown; a − sign indicates that the distance should be diminished by the amount shown.

Colours	Change	Colours	Change
1 and 2	−0·83	14 and 15	−0·50
5 and 6	−0·58	16 and 17	−1·00
7 and 8	+0·75	18 and 19	−0·92
12 and 13	+1·17	20 and 21	−0·25
13 and 14	+0·17	24 and 1	+1·58

It is clear that in view of these results the validity of Ostwald's claim must be seriously doubted.

(*c*) For testing Ostwald's third claim, eight grey *harmonies* were constructed in accordance with his specifications, and eight grey *combinations*, made up to contravene his principles. The size of the inequality in these combinations varied from 1 to 3 steps. The 16 triads were ranked in order of liking by six subjects, the average intercorrelation between them being 0·49. The average order of these subjects would correlate with the true order of the whole population of which they were only a sample to the extent of approximately 0·92 (footnote 6, and references); hence we may take their average ranking as a fairly close approximation to the 'true order'. On the average, the *harmonies* are ranked 8·7, the *combinations* 8·3; in other words, if anything the *combinations* are preferred. The best-liked triad is a combination, the least-liked a harmony. This adverse result seems due, however, not so much to any fault in Ostwald's proposed law, as rather to the inaccuracy of the spacing of the greys in his system; introspective evidence shows that the combinations and harmonies most preferred are those in which the differences are seen as equal.

(*d*) To test Ostwald's last claim, 48 diads were used. There are 24 diads which have a circle distance of 8 steps; in addition 12 diads were included with a circle distance of 5 steps and another 12 with a circle distance of 11 steps. Ten subjects arranged these forty-eight diads in order of liking, giving the following average number of points to each group (a scheme of grouping, closely following the normal distribution curve, was adopted in the ranking, as with 48 items the assumption of linearity implicit in the straightforward ranking procedure is likely to be false):

Circle-distance, 5 steps: 3·8 points.
Circle distance, 8 steps: 4·5 points.
Circle distance, 11 steps: 5·2 points.

Thus on the average the greater the circle distance, the better liked were the diads. This finding bears out Kirschmann's First Law, namely, that "combinations are pleasant if they yield a maximum . . . contrast effect"[7]. Additional experiments, involving the ranking of the 24 constituent colours of the diads by the same subjects, also confirm his tenth law, namely, that "the pleasantness or unpleasantness of the single colours affects the pleasantness or unpleasantness of their combinations". The influence of these two factors seems to be about equal, each contributing some 25 per cent to the final ranking.

Thus here also, as in the previous experiments, empirical investigation fails to support Ostwald's claims. In spite of this disappointing conclusion, I believe that the main aims which Ostwald hoped to reach are eminently worth while, and that a repetition of his work with the proper statistical and experimental safeguards would lead to great progress in those applied arts and sciences which to some degree depend on colour, such as art teaching, poster designing and camouflage.

[1] Ostwald, W., "Colour Science" (London: Windsor and Newton, 1931).

[2] Guild, J., NATURE, **129**, 453 (1932).

[3] Barnhart, E. N., *J. Exp. Psychol.*, **25**, 506 (1939).

[4] König, A., and Brodhun, E., *Akad. Wiss. Berlin, Sitzber.*, **37**, (2), 917 (1888).

[5] Burkamp, W., *Z. Psychol.*, **55**, 2, 133 (1923).

[6] Eysenck, H. J., *J. Exp. Psychol.*, **25**, 650 (1939).

[7] Kirschmann, A., Univ. Toronto Stud. Psychol., Series 1, 177–200 (1900).

CONDENSING PLANT FOR POWER STATIONS

THE design of steam condensing plant and associated cooling water systems for power stations was considered from the economic point of view in a paper by W. T. Bottomley (Messrs. Merz and McLellan, consultants) submitted to the North East Coast Institution of Engineers and Shipbuilders at Newcastle-upon-Tyne on March 28.

Mr. Bottomley showed that the condensing plant should be designed to fit the circulating-water system, the ratio of the quantity circulating to the tube surface area depending on the length of the water system. Thus for a station close to the bank of a non-tidal river, the ratio should be considerably larger than when tidal water can be utilized. Data are included indicating the performance of the condensers at the Dunston "B" station of the North-Eastern Electric Supply Co., together with the results of cooling tower tests carried out at the Darlington municipal generating station.

Mr. Bottomley's deductions are that the economical water velocity through the tubes, the size of condenser, quantity of water circulating and size of cooling tower can each be determined independently of the others and depend on cost ratios, as does also the economical ratio of water to the surface in the condenser.

Under dirty conditions, the economical load on a condenser should be about 5,300 B.Th.U. per sq. ft. for base-load stations, instead of the generally recommended figure of 7,000. When the size of the turbine house building is fixed, it pays to install the largest condenser possible in the space available.

The relation between the normal vacuum in the condenser and the average temperature of the inlet circulating water has been practically fixed by convention. The sizes of condensers built in the United States are much the same as those built in Great Britain, but the quantity of water used is sometimes greater. Port Washington Power Station (U.S.A.) is the most efficient power station in the world. Monthly and yearly average operating figures are published from time to time. In 1937 the average load for the machines was nearly steady at 53,000 kilowatts. The greatest monthly average temperature rise of water, 4·2° F. above that of the circulating water inlet, occurred in March, and the smallest rise, 4·0° F., occurred in August. The temperature rise of the circulating water of about 4·0° F. shows that the quantity of the circulating water is nearly 250 times the quantity of the steam condensed. It has to be noted that whatever the conventions adopted twenty years ago, prices and conditions have now considerably altered. The most important of these is the average loading of the plant, which, especially in base-load power stations, is considerably higher now than ever before. The cost of fuel per kilowatt-hour has not materially altered. The fuel consumption per unit has been reduced to a half during the last thirty years. This has been offset to a large extent by the rise in the price of coal, which is now double what it was. When river water is used for cooling, the temperature of the water is the theoretical lower temperature of the cycle; for cooling tower schemes it is the atmospheric wet bulb temperature. In a given locality, these two temperatures on the average are about the same: for example, about 52° F. in Great Britain.

The approach of the condensing temperature to the theoretical temperature is limited by the question of cost, and the aim of the engineer is to design the plant so that the total annual cost including capital charges is a minimum. Mr. Bottomley shows mathematically that for conditions of minimum cost, the size of the condenser, the size of the tower and the quantity of circulating water can each be determined independently of the others, and this considerably simplifies the problem.

Among the important conclusions deduced is that the effect of deposit on the tubes can only be counteracted by increasing the tube surface and reducing the water velocity. No advantage is gained by increasing the quantity of the circulating water. Bearing in mind the cost of the circulating-water system and the cost of pumping, it is clear that the longer the circulating-water system is, the more the quantity of the circulating water should be reduced and the lower should be the normal vacuum in the condenser. Subject to the ground being suitable to bear the weight, power stations using tidal-river water cooling should be placed as near as possible to the river front, as this reduces the length and cost of the circulating-water system and also improves the overall efficiency of the station. By placing the station on the river front, a saving of about one per cent in the fuel consumption can be effected without reducing the distance between the intake and the discharge to the river, compared with a station placed about 800 ft. from the bank.

PLANNING IN GREAT BRITAIN

A CONFERENCE on National Planning arranged by the Garden Cities and Town Planning Association was held at Oxford on March 28–30. An abstract of the valuable survey presented by Dr. Dudley Stamp at the Conference has already appeared in NATURE of May 24, p. 647. In what follows, digests are presented of some of the other contributions.

Mr. D. E. Gibson's paper on problems of decentralization, central development and satellite towns, while outlining the plans adopted by the Coventry City Council as a basis for Lord Reith's investigation, was essentially a discussion of some of these fundamental problems. It is obvious that we must have an idea of the size of the city for which we are planning before any intelligent planning is possible, and this is true whether of amenity services or of such problems as transport and roads. Such a question can only be answered when national planning arrangements have been made. National planning by the Government, as Mr. Gibson points out, is vital, because such information is required by all planning authorities in the country.

The valuable reports of the Barlow Commission and of P E P (Political and Economic Planning) do not supply all the material that is required as a basis for legislation, though the Conference re-directed attention to them, and Mr. H. W. J. Hick in particular, in his paper on "The Machinery of Planning", urged the adoption of the findings of the Barlow Commission with the reservations and amendments of the signatories of the Minority Report. The field for further investigations, however, is admirably illustrated in some notes for discussion on planning principles by Mr. W. Harding Thompson, which formed one of the most valuable contributions to the Conference.

Mr. Thompson shows that while there may be general agreement as to the objectives of planning, and the argument for decentralization may be regarded as accepted as a basis of policy for the central planning authority, changes occurring during the War must be taken into consideration. Some war factories may form the nuclei for new industrial settlements, but the central authority must at least provide a general outline plan on very broad lines for national zoning of industry. This plan, moreover, must take account of the balance of community life as well as of other economic and æsthetic factors. Planned redistribution is probably best applied to the numerous light and mobile industries with their wide choice of location.

The unit of regional planning also requires consideration in the light of experience of the civil defence regions. Mr. Thompson throws out as one suggestion the formation of industrial and agricultural planning boards, and stresses the necessity of harmonizing conflicting requirements of various

Government Departments by the central or regional authority before transmission to local authorities, if local planning schemes are not to be delayed and confused. He reiterates with Mr. Gibson the importance of a local planning authority or joint committee deciding on the optimum size and population of a town before planning for increased industrial activity. Expansion beyond that size should be by means of adjacent satellite or independent new communities within the region, each surrounded by a green belt.

The question of the optimum size of towns is one of the major problems on which further research is required. Obviously it may vary in accordance with physical limitations, the character and function of the town, the labour conditions, possible services, strategic situation and population required to support cultural activities, etc., and the analysis in the P E P report requires extension to some practical conclusion. The maximum density of development for urban areas, especially in residential units, is another matter in which further guidance is required, while the relation of agricultural to other industries established in rural districts needs investigation in several respects. The possibility of a further decrease of agricultural workers in Britain after the War, due to scientific and mechanized methods of farming and as a part of Imperial agricultural policy, must be seriously considered both in its effect on the vitality and mortality statistics and in relation to food policy and possible changes in production such as extended market gardening. Equally we have to consider the possibility of stabilizing and revitalizing rural community life by the introduction of selected light industries in villages, and the ways and means of safeguarding the benefits in health which have already flowed from the closer contact through evacuation of town workers with rural life.

Prof. J. H. Jones advocated the immediate establishment of regional boards, under the chairmanship of the Civil Defence Commissioners, to control the location of industry, and urged that the Government should decide whether the present Ministry of Works and Buildings is to be the effective Ministry of Reconstruction or to be superseded. Dr. Robson, in stressing the advantages of immediate planning to the war effort, holds that industry is capable of more control in its location than Prof. Jones suggested.

There can be no doubt that there are wide fields in which the planning of post-war Britain and the research and technique involved in reconstruction could be undertaken now with direct advantage to our war effort, apart altogether from the effect on public morale. There is much educational work to be undertaken, not merely of the general public, but also post-graduate education in such fields as organic planning, quantitative study of zoning areas, factory-building, shopbuilding, leasing and rent-fixing, control of use and design—aspects and techniques of town-building which, as Mr. F. J. Osborn pointed out, are not adequately covered in present town-planning education. There is also the vital contribution of the Building Research Station in regard to the use of new materials of construction as well as in matters of design, and here again research must be linked up with the development of new techniques and much far-reaching educational work.

CRUSTAL STRUCTURE OF NEW ZEALAND

K. E. BULLEN states that the progress of instrumental seismology has been slower in New Zealand than in a number of other earthquake regions, and it was not until the present decade that the identification of phases other than the normal P and S could be made in the records of near earthquakes (K. E. Bullen, "The Crustal Structure of the New Zealand Region as inferred from Studies of Earthquake Waves", Proc. Sixth Pacific Science Congress, 1939). The subsequent studies of the crustal structure of the New Zealand region have been subject to a number of special difficulties, of which some, but not all, have since been resolved or modified.

These difficulties centre chiefly around the considerable uncertainties in the determination of epicentres and origin times of many of the earthquakes which have shown phases in addition to P_n and S_n. Epicentres are in general best determined from the absolute arrival times of P_n at a sufficient number of stations, but until recently Wellington and Christchurch were the only stations the absolute time of which could be relied upon for such a purpose. This has necessitated recourse to $P_n - S_n$ intervals with the attendant difficulties of the accurate identification of the onset of S_n. There were doubts also concerning the normal P velocity immediately below the crustal layers, and therefore by implication in the corresponding S velocity also. A step forward was taken by Bullen when the significance of the phase S^* was recognized in New Zealand earthquakes, following a study of the aftershocks of the Hawke's Bay earthquakes of February 2, 1931. It would appear that S^* has been recorded more often than any other phase in New Zealand and that S^* may sometimes be recorded when the normal S_n is completely missed. A revision of the analysis of the Wairoa earthquake of September 15, 1932, and of the Pahiatua earthquake of 1934 has led to further improvement. Statistical methods have been used wherever possible.

The new epicentre of the Wairoa earthquake was considered so satisfactory that new travel-time curves were prepared which, Bullen believes, approximate to the best results obtainable for the New Zealand region on the data so far available. The data refer particularly to that part of New Zealand which lies between latitudes 38·5° S. and 43·5° S. From these data P^n up to 4° has a velocity of 8·1 km./sec. though the normal 7·8 km./sec. fits nearer 6°. There are signs that P^* is double with velocities 6·55 and 6·0 km./sec. $P_{6\cdot0}$ and $S_{3\cdot0}$ have additionally been recognized, the former making S_n difficult to recognize at some stations. $P_{5\cdot0}$ has also been recognized by geophysical prospectors in New Zealand and may correspond to travel paths through greywacke, which occurs abundantly in the region between Wairoa and Wellington.

In conclusion, it is suggested by Bullen that the structure may be: (1) uppermost layer, perhaps a greywacke for a good part of the region, thickness 5–10 km. with velocity of P 5·0 km./sec. and S 3·0 km./sec.; (2) granitic layer, 4 km. thick with velocity of P 5·5 km./sec.; (3) intermediate layers, 10–20 km. thick altogether with velocities of P 6·0, 6·3, 6·5 and 7·0 km./sec. and in the lower part S 3·7 km./sec.; (4) lower layer dunite with base uncertain, velocity of P 7·8 (?) km./sec. and S 4·4 km./sec. This varies somewhat from the European structure, chiefly in having a thinner granitic layer and a thicker intermediate layer than Europe. The phase $P_{6\cdot 0}$ may correspond to the phase P_Y in California, and it is suggested that there may be some resemblance between the crustal structures of New Zealand and Japan.

PLANTS USEFUL AND ORNAMENTAL

UNLESS he be a professed systematist, the modern botanist, newly arrived in the tropics, as also the horticulturist and agriculturist, may well find himself bewildered and dismayed, as well as bewitched, by the diversity and profusion of the vegetable forms which everywhere greet the eye. Those first encounters, indeed, provide a pleasure not entirely devoid of pain; they force a realization of the small knowledge that one so often brings to a vast subject. Such local works as afford simple and direct guidance in the identification of the more common genera and species are therefore of great value and should be appreciated accordingly.

In this category is the volume just issued by R. O. Williams and R. O. Williams, jun. ("The Useful and Ornamental Plants of Trinidad and Tobago", third edition, Government Printers, Trinidad), the original edition having been published by W. G. Freeman and R. O. Williams in 1927 and a second in 1928. The object, in the first instance, was to give information about native and introduced plants possessing interest because of their useful and ornamental qualities. Actually, a brief random sampling shows that the title errs on the side of modesty, for many plants, not essentially useful or ornamental, but of considerable botanical interest, are also described—a feature not only desirable in itself but also one which lends a fullness to the work.

The Colony, as the authors state, possesses many wild plants, prized for their economic or decorative value; and many plants have been successfully introduced from all parts of the world. "To obtain information on many of these is often difficult, even in a well appointed botanical library, entailing search through various standard works of reference, and often the agricultural, botanical and other publications of several other countries. To the person not so equipped the task is frequently a hopeless one." Thus appreciating the need, the authors have successfully fulfilled their task. In this edition the lists of useful plants have been completely rearranged and keys have been provided to facilitate identifications. Cultural notes make a useful addition to plant descriptions and notes on crop plants have been brought up to date.

It is a pleasant occupation to make an excursion at random through such a work, where East meets West and where the denizen of the high woods comes to rest by the side of more everyday garden staples, but for the botanist the features of greatest interest are perhaps those sections where orchids, ferns, grasses, cycads, conifers, cacti and mangroves are treated as groups. At a glance the wealth of the Islands can be seen. Further, what is true of the major groups is true of the flora as a whole; the number of native and introduced plants possessing particular interest is surprising.

FORTHCOMING EVENTS

Thursday, June 5

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1) at 5.30 p.m.—Prof. Julian Huxley, F.R.S.: "Art as a Social Function" (Lloyd Roberts Lecture).

CHEMICAL SOCIETY, INSTITUTE OF CHEMISTRY, and SOCIETY OF CHEMICAL INDUSTRY (Joint Meeting in the University Chemical Department, Bristol) at 6.30 p.m.—Prof. G. M. Bennett: "Liquid Crystals".

APPOINTMENTS VACANT

LECTURER IN MECHANICAL ENGINEERING—The Principal, Aston Technical College, Whitehead Road, Birmingham 6 (June 7).

LECTURER IN PHARMACY and LECTURERS IN MECHANICAL ENGINEERING—The Principal, Central Technical College, Suffolk Street, Birmingham 1 (June 7).

SENIOR LECTURER IN THE DEPARTMENT OF ELECTRICAL ENGINEERING—The Principal, Heriot-Watt College, Edinburgh (June 9).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Annual Report of the Oundle School Natural History Society. Pp. 20. (Oundle: Oundle School.) [55

Scientific Proceedings of the Royal Dublin Society. Vol. 22 (N.S.), No. 38: The Vitamin D Requirements of the Growing Pig. By Brendan J. Senior. Pp. 379–386. 6*d*. Vol. 22 (N.S.), No. 39: Studies on the Oxidising Action of Selenious Acid. 1: Organic Sulphur Compounds. By A. E. A. Werner. Pp. 387–392. 6*d*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [55

Catalogue of 20,554 Faint Stars in the Cape Astrographic Zone −40° to −52° for the Equinox of 1900·0 giving Positions, Precessions, Proper Motions and Photographic Magnitudes derived from Photographs taken at the Royal Observatory, Cape of Good Hope, under the direction of Dr. H. Spencer Jones and Dr. J. Jackson; also Spectral Types classified from Plates at the Harvard College Observatory, Cambridge, Mass., U.S.A., by Miss Annie J. Cannon. Pp. lvii+414. (London: H.M. Stationery Office.) 42*s*. net. [75

Observations made at the Royal Observatory, Greenwich, in the Year 1936, in Astronomy, Magnetism and Meteorology, under the direction of Dr. H. Spencer Jones. Pp. vii+A78+B16+Cix+161+D66+E46+38. (London: H.M. Stationery Office.) 35*s*. net. [75

Reports on Progress in Physics. Vol. 7 (1940). General Editor: J. H. Awbery. Pp. iii+362. (London: Physical Society). 22*s*. 6*d*. net. [135

Other Countries

Annals of the Carnegie Museum. Vol. 28, Art. 12: A New Crocodilian, *Hassiacosuchus kayi* from the Bridger Eocene Beds of Wyoming. By Charles C. Mook. Pp. 207–220+plates 23–25. (Pittsburgh, Pa.: Carnegie Museum.) [75

Smithsonian Miscellaneous Collections. Vol. 99, No. 21: A New Shipworm from Panama. By Paul Bartsch. (Publication 3632.) Pp. ii+2+1 plate. (Washington, D.C.: Smithsonian Institution.) [85

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1940. (Publication 3631.) Pp. v+100. (Washington, D.C.: Smithsonian Institution.) [85

Annual Report of the Director of the Japan Institute for Science of Labour for 1939. By Dr. G. Teruoka. Pp. ii+14. (Tokyo: Japan Institute for Science of Labour.) [85

United States Department of the Interior: Fish and Wildlife Service. Wildlife Circular 6: The House Rat. By James Silver. Pp. iv+18. (Washington, D.C.: Government Printing Office.) 5 cents. [95

University of Bombay: Department of Chemical Technology. Annual Report, 1939–40. Pp. 28. (Bombay: The University.) [95

Imperial Council of Agricultural Research. Scientific Monograph No. 14: Further Studies on Cereal Rusts in India. By Dr. K. C. Mehta. Pp. vii+224+12 plates. (Delhi: Manager of Publications.) 6 rupees; 9*s*. 6*d*. [95

Memoirs of the Geological Survey of India. Vol. 63, Part 3: The Stratigraphy of South Singhbaum. By Dr. J. A. Dunn. Pp. iv+303–370+ix+plates 33–37. (Calcutta: Geological Survey of India.) 1.14 rupees; 2*s*. 9*d*. [95

Publications of the Observatory of the University of Michigan. Vol. 8, No. 5: The Spectrum of Nova Cygni III (1920). By Ralph B. Baldwin. Pp. 61–94+2 plates. Vol. 8, No. 6: The Francis C. McMath Memorial 24-inch Reflecting Telescope of the McMath-Hulbert Observatory. By Robert R. McMath. Pp. 95–102+6 plates. Vol. 8, No. 7: Dimensions and Shape of the Andromeda Nebula. By Robley C. Williams and W. Albert Hiltner. Pp. 103–106+1 plate. (Ann Arbor, Mich.: University of Michigan.) [95

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ECONOMIC POLICY TO-DAY AND TO-MORROW

RECENT debates in the House of Commons, notably on the War Damage Bill, have amply vindicated the value of our democratic institutions in sustaining and guiding the national effort. Without questioning its confidence in the present Government, the House of Commons shows no signs of abdicating its associated practice of vigilant supervision and the voicing of public opinion ; and by its co-operation with the Government as a kind of Council of State, while maintaining its vigilant watch over policy and achievement, its sensitive interpretation of public opinion and constructive but searching criticism of administration has gone far to rehabilitate the prestige of Parliament and silence criticism which was rampant in the years immediately before the War. Mr. Pethick-Lawrence claimed with justice that in the War Damage Act debates we see democracy at its best, and Sir Percy Harris added that "the Chancellor has justified, in war-time, the working of the democratic machine. The House of Commons has been for this Bill, a Council of State." Much the same could have been said of the recent debate on the War, when keen criticism was focused on those questions of production and man-power which have so far restricted severely our policy and our strategy.

Nor is the House of Commons alone in exercising such functions. It is reinforced by its own Select Committee on National Expenditure, the reports of which, inspired by a wide view of its functions, have been models of the type of searching scrutiny and constructive proposals demanded, and have admirably supplemented the work of the House of Commons. Other bodies also are maintaining a watchful attitude. Among them is the Vigilance-for-Victory Group, composed primarily of politicians, prominent newspaper men and publicists who can report accurately upon public opinion and give it expression, and experts of trade and the professions affected by the problems which the Group examines. Its bulletins are complementary to the admirable contributions which the broadsheets issued by Political and Economic Planning (P E P) have already made to the national effort, and they supply an example of the type of contribution which scientific workers themselves may be expected to make in their own particular fields.

Informed, searching and constructive criticism is one of the first duties of the scientific worker ; there should be no excuse for slackness in this field either through failure to use effectively the machinery already established, from the Scientific Advisory Committee downwards, or to create new machinery if that already in existence is inadequate. They have, as it were, to play the same part as the Observer Corps to the Fighter Command, watching each situation as it develops in fields that are their special concern, and as quickly mobilizing expert opinion to consider and recommend effective and urgent measures to the authorities.

This is the view of its own functions taken by the Vigilance-for-Victory Group and is reflected in its fourth bulletin, which deals with the new plans of the Minister of Labour and National Service. The bulletin agrees with Mr. Bevin that compulsion should be avoided wherever possible on account of its effect on morale, but considers that more could have been done to reduce the need for compulsion by the comprehensive organization of all productive resources, especially of the distributive trades, which are probably the largest untapped source of man-power ; by a rational wages policy designed to facilitate the transfer of workers from non-essential to essential work ; and by a training scheme more attractive and extensive than that now in force. The measures now announced, it is considered, will not yield an adequate turnover of labour unless accompanied by an undesirable amount of compulsion. To be effective they must be supplemented by economic and financial planning of the kind which the Government has been reluctant to undertake.

Recent changes in the Government may indicate a belated move in this direction. The new appointment of Lord Beaverbrook as a Minister of State free from departmental duties may betoken recognition of the value of Cabinet Ministers capable of detached views and of co-ordinating policy, while the merging of the Ministries of Transport and Shipping is obviously intended to facilitate co-ordination. They are, however, only a short step towards the measures which the Vigilance-for-Victory Group believes are necessary.

In the sphere of industrial reorganization, the first need is to establish a pooled and controlled industrial machine, so as to increase productivity and facilitate the transfer of labour. The machinery for distributing orders for military and other supplies must then be reformed on a unified basis, and in the distribution of orders between localities the question of adequate labour supply must be one of the most important considerations. This latter point is also strongly made by Mr. G. D. H. Cole in an article on man-power in the *Political Quarterly* of April–June; Mr. Cole suggests that the regional shortage of workers is likely to be the principal difficulty in the way of expanding the output of munitions during the next twelve months.

This question is linked up with man-power policy, where the evolution of a national wage policy is the first essential. This depends on a rational consumption and price policy, that is, rationing, and on the establishment of a central wages tribunal. Revision of the wage structure is the next essential, including overtime for night shifts, so that it stimulates the transfer of labour where it is required. As a revision of relative wages must take place by an upward revision of the wages paid for occupations where man-power is needed, this depends, if inflation is to be avoided, on a strict rationing of goods. To improve the unsatisfactory position of training, the Vigilance-for-Victory bulletin, like Mr. Cole, recommends that training be paid as a job. Moreover, to prevent injustice or profiteering, billeting should be compulsory on the householder and all extra costs resulting from the transfer of labour borne by the State; stress is also laid upon finding a logical plan of compensation in place of the present system of allowances for members of the Fighting Forces.

Regional committees of production experts, with power to enforce their advice as to training, direction and use of skilled workers should be established, without interference from the Supply Departments, and appropriate social services should be introduced where necessary to increase the supply of man-power. These measures would go far to achieve the necessary transfer of labour by voluntary action. Certain measures enabling the Government to use compulsion, however, should also be enacted. The prohibition against leaving employment without permission should be replaced by a general prohibition of hiring without permission, and people not at the moment employed in industry should be required, by registration, to show reason why they are not in employment. If they do not fall into certain well-defined exempted categories, they should be asked to undertake suitable work. Modification of the unemployment insurance and assistance schemes for the duration of the War, securing to all displaced labour its previous wage and subsistence and separation allowances, provided it accepts training or suitable jobs, accompanied by a stringent and fair distribution of available supplies and goods by compulsory mobilization of property, and a fair system of taxation, would limit direct compulsion primarily to compelling *entrepreneurs* to reorganize production on a war-time basis. Reorganization on the supply side would minimize the necessity for migration, which is now causing most of the friction, discontent and bottlenecks.

These conclusions and recommendations are strikingly in harmony with the main points made by Mr. Cole, who considers that the problems arising out of migration—billeting, difficulties of transport and allowances and irrational differences in wages and earnings between one district and another—are the most serious obstacle to the full utilization of the available man-power of Great Britain. The second principal obstacle is the continuance, despite Government control, of each privately owned business as a separate unit, with which the Government departments enter into separate contracts. He considers that man-power could be much more effectively applied if the Government took over completely all the important munition-making firms, and pooled their resources in each locality under unified local management—in any event to the extent of grouping all firms engaged in closely related types of work. This step, by assisting transference, would help immensely to solve the other problems of labour migration.

Industrial mobilization is now proceeding on definite lines whether or not the pace can yet be regarded as satisfactory. The notion of a total war economy using all available reserves, specialized or otherwise, is gaining ground and the principle of complete concentration of those industries which are being contracted because they do not contribute directly to the war effort or to the maintenance of civil life has been unhesitatingly accepted. If, however, it is to be worked out adequately, it may be necessary for the Board of Trade to accept greater responsibility for directing industry towards the agreed ends. Certainly it cannot be achieved unless the policy of concentration and distribution of man-power is guided by a scientific and carefully worked-out plan.

Mr. Lyttelton in recent speeches has indeed shown an encouraging grasp of the essentials of war economics, and his statement of the Government's economic objectives in the War shows that it has already begun to think about post-war economic policy. These objectives he put under five heads: the mobilization of plant, raw materials, shipping, etc., for war production; secondly, the rationing of the civil population so that only essentials are made; thirdly, the mobilization of man-power; fourthly, the avoidance of inflation and the cheap finance of the war; and fifthly, the starting of the creation of post-war plans. Mr. Lyttelton already has a special section charged with examining particularly the problems of the first two or three years after the War.

Once again, then, we find that the war effort is linked up with post-war plans, and on this aspect Mr. Lyttelton makes two points. Internationally, we shall be a debtor nation and may require to continue a selective export policy and to control imports. We shall also have to prevent an unregulated replacement boom. Government control of industry can therefore only slowly be released, and must continue for some time after the War. The economic peace must rest on domestic and international regulation and co-operation. These points were elaborated in the speech made by Mr. Anthony Eden, on May 29, when he pointed out, among other matters, that the British Empire and Allies with the United States and South America will alone be able to undertake the reconstruction of Europe, and that "it will be our wish to work with others to prevent the starvation of the post-armistice period, the currency disorders and the wide fluctuations of employment, markets and prices" which followed the War of 1914–18.

Whatever may be thought of the adequacy of particular solutions, we are moving far from the assumptions on which our pre-war discussions of trade and the control of industry were based. We must be prepared for and endeavour to create a new technique in economic government. Mr. Lyttelton's emphatic vindication of the Government's economic policy as inspired by a comprehensive plan embracing the whole problem and clearly relating each part to every other should induce scientific workers to see that the framework of scientific co-operation and organization is adequate both to the demands of war-time and to the reconstruction to follow.

STARS AND ATOMS

The Birth and Death of the Sun

Stellar Evolution and Subatomic Energy. By Prof. George Gamow. Pp. xv+238+16 plates. (London: Macmillan and Co., Ltd., 1941.) 12*s*. 6*d*. net.

The World and the Atom

By C. Møller and Ebbe Rasmussen. Translated from the second Danish edition by Gerald C. Wheeler and Bernard Miall. Pp. 200. (London: George Allen and Unwin, Ltd., 1940.) 10*s*. 6*d*. net.

It is often alleged that men of science are culpably indifferent to the cultural and intellectual needs of the society in which they live and work. The tremendous uprush of scientific discovery during the last fifty years, an uprush which as yet shows no signs of abating, has raised social and intellectual problems which make it imperative that the man in the street should acquire some appreciation of scientific method and the results of its application, if only that he may be able to distinguish the true prophet from the charlatan. It has even been suggested by a recent correspondent to Nature that the education of the public in general, and of the leaders of public opinion in particular, may be the most valuable service which scientific workers can render the community.

If the charge of culpable negligence in the discharge of this duty was ever fairly levelled against men of science as a whole, which I must not stay to argue, a number of books have appeared within the last year or so of a quality and attractiveness which must at any rate secure an acquittal for the physicist. It is not very long since Gamow's "Mr. Tompkins in Wonderland" told the general reader all that he is likely to know of quantum theory and relativity; and wise folks who procured a copy of George Russell Harrison's "Atoms in Action" (see NATURE, December 14, 1940, p. 760) will have enjoyed an authoritative and admirable picture of the state of applied physics. The reader who, with appetite increased by what it fed on, asks for more, can be recommended to the books listed at the head of this notice, which deal with still other aspects of modern physics.

Gamow deals with some of the major problems of astronomy: Møller and Rasmussen with the riddle of the atom and its nucleus; the one with the infinitely large, the others with the infinitely small; but it is extraordinary how much ground the two books have in common. This is more than a coincidence. It is an illustration, and a very good one, of the essential unity of all research. A successful attack on one obscure part of the subject may lead to a sweeping advance all along the line; and the work of the 'atom-smasher' in the darkened laboratory has enabled the astrophysicist to write a new chapter in the history of the universe. The moral of this may be left for participants in the "Science and Politics" correspondence to draw.

Astronomy has always had its devotees. The mysteries of the heavens have always excited the wonder of mankind, and wonder is the legitimate parent of research. The question as to how the sun came into being, whence it draws its enormous supply of energy, and what is to be its ultimate fate must excite speculation and interest. Its solution, involving, as it does, the application of the principles of physics to conditions of temperature and pressure far exceeding anything available in terrestrial laboratories, demands the exercise of controlled imagination of the highest order. Some chapters of the story have already been written by Eddington and Jeans. Recent work on the transmutation of the elements begun by Lord Rutherford and now being extended by a host of physicists has added a new chapter to the tale. In brief, the extremely high-tension apparatus designed for 'atom-smashing' is able to give to a few particles a degree of energy of the same order of magnitude as that which they habitually possess in the interior of the sun. By hurling these high-speed particles at atoms of various kinds it is possible to study, on a very microscopic scale, reactions which must be going on, on an enormous scale, in the sun's interior. It is well known that energy on a large scale is set free in some of these reactions, and mankind has begun to look wistfully, but not very hopefully, to the day when it may be able to draw on this sub-atomic energy. It now turns out that our sun and its fellows have been tapping this great reservoir for ages.

It is an exciting story, and Prof. Gamow tells it extremely well. He has two great qualifications for the task. In the first place he has been closely connected with the work described, and gives to it all the vividness of an eye-witness's narrative. Secondly, he so obviously enjoys the story himself. The pursuit of a new physical problem clearly gives him all the fun and excitement of the chase, an excitement which he communicates to his readers. Prof. Gamow has a real flair for making difficult ideas appear simple, and an engaging sense of humour which not only breaks out in the text, but also illuminates the pictures and diagrams with which he has himself illustrated the book.

"The World and the Atom", by Møller and Rasmussen, is a scholarly account of the rise and progress of atomic physics from its inception at the beginning of the century to about 1938. The authors, one a theoretical the other an experimental physicist, are members of the Institute in Copenhagen presided over by Prof. Niels Bohr, who contributes a foreword. The book is a clear and well-balanced history of one of the great formative periods in science. The gradual introduction of new and ever-broadening conceptions into the structure of physics is clearly traced; and the essential parts played by the experimental physicist, the mathematician, and the technologist, and their reactions upon each other, are ably demonstrated.

In standard the book seems to lie somewhere between the entirely 'popular' and the elementary text-book. A student of modern physics would find it of value in co-ordinating his ideas, while the serious layman, wishing to gain an intelligent appreciation of one of the outstanding achievements of our age, should not find it beyond his powers. The book suffers a little from a certain heaviness in style which seems almost inevitable in a translation, but there is no lack of clarity.

Both books are excellently produced, and illustrated with diagrams and plates. Some of the Mount Wilson photographs of celestial phenomena reproduced in "The Birth and Death of the Sun" are a sheer delight.

J. A. CROWTHER.

RESEARCH ON MOTOR-CAR ENGINES

Collected Researches on Cylinder Wear
By C. G. Williams. Pp. vii+119. (London: Institution of Automobile Engineers, 1940.) 10*s.* 6*d.*

THE work being carried on at the research station of the Institution of Automobile Engineers at the Great West Road, Brentford, which was outlined in a description of the Laboratory in NATURE of November 23, 1940, is exemplified in the publication of "Collected Researches on Cylinder Wear", by C. G. Williams.

It is pointed out in the late Lord Austin's foreword that the problem of cylinder wear is one of the most serious with which motor-car manufacturers have had to deal. Individually, they have done much useful work towards its solution in their own laboratories, but owing to its complexity it was thought best to have it dealt with comprehensively by the Institution, and the several reports which constitute this publication confirm the advantage of this arrangement, not only in unifying the direction of the investigations but also in bringing together and releasing for general use the full range of information collected.

These collected researches include four interim reports on experiments carried out at the Institution's Laboratory, a discussion of published information on the subject, the collected experiences of manufacturers and operators giving the accumulated data prior to the adoption of the work at the new laboratory, a later report of more recent experiences and the results of an investigation of cylinder liner materials.

It had been suspected for some time that it was during the initial warming-up period that wear mainly takes place, but this partial knowledge led to an accentuation of the trouble as, in ignorance of the main source of wear, a wrong procedure was adopted. The contributory causes are many and various, associated as they are with mechanical and frictional conditions, the properties and chemical reactions of fuel and exhaust gases, high temperature, composition and structure of the metals in contact, influence of lubricating oils and so on. It is proved, however, that corrosion, not abrasion, is the main cause of cylinder wear, and there are several sources from which it may arise. Besides the action of water, which, as shown, can cause corrosion through oil films, there is the certainty of acidic conditions being produced from organic acids, sulphuric, nitric and carbonic acids derived in small proportions from the normal components of the fuel. The investigation of these miniature chemical processes will be found one of the most interesting phases of this series of researches, dealing as they do with many other complex and almost infinitesimal actions and reactions.

These researches were carried out with the view of making immediate use of the knowledge gained in the improvement of engines, and the report dealing with the more recent experiences of manufacturers and operators bears out their value. One improvement of major importance is the use of more suitable cylinder materials; special reference is made to nitrogen-hardened cast iron with its resistance to abrasive wear, and to austenitic cast iron, which can withstand both corrosive and abrasive wear. On many other points, this section gives details of the practical results which have accrued from the work of the Laboratory.

AGRICULTURAL PRODUCTION IN UGANDA

Agriculture in Uganda
By the Staff of the Department of Agriculture, Uganda. Edited by Dr. J. D. Tothill. (Published by authority of the Government of the Uganda Protectorate.) Pp. xvi+552+30 plates. (London: Oxford University Press, 1940.) 20*s.* net.

THIS is a comprehensive volume of information contributed by the staff of the Department of Agriculture in Uganda on agricultural conditions—including native agriculture, land tenure, soils, manures—imported, artificial, green and cover crops; climate, crops and allied subjects. The important associative sciences of mycology and entomology are also dealt with very thoroughly, the fungus and insect pests being discussed at length under each crop, though bees and locusts are treated in a separate section.

Under "Native Agriculture: Development of Ox-Cultivation", it is recorded that chiefs in Budama were first instructed in the use of the plough in 1909 and a ploughing school was started in 1910 at Kumi (in Teso). The first ploughs used in Teso were wooden, made locally from an Indian pattern; but, these, it is stated, were soon discarded in favour of European iron ploughs. Various types of these appear to have been tried, and the one most in favour at the present time is Ransome's "E.C.A." Other implements, ox-cultivators, etc., have been tried, but they do not appear to have come into general use. The tillage operations after the plough are still done by hand, which, the author of this subject states, is "one of the limiting factors to increased acreage of cotton by means of the plough".

It is not possible within the limits of this notice even to enumerate all the plants grown; but a few details of the main items may be mentioned, the production of which is fully discussed under various headings, mainly: "Native Food Crops: Sweet Potatoes, Cassava and Yams; the Cereals—'Bulo' (*Eleusine*), Maize, Sorghum, Rice and Wheat; Ground Nuts, Simsim (seed of *Sesamum*) and the Pulses—Pigeon Peas, Cow Peas, Tepary, Soy and Haricot Beans."

Fruits and vegetables are given a special section covering pp. 485–495. The most important fruits of Uganda, it is stated, "have been introduced, many are cultivated by the Natives for their own consumption and for sale in the markets of the towns." The principal fruit is the banana, to which a whole chapter is devoted (pp. 111–125). Some particulars are given of citrus fruits, the mango, avocado pear, guava, pine-apple, papaw and passion fruits; the record concluding with an extensive list of miscellaneous fruits, tropical and temperate, introduced into Uganda.

Under "Vegetables"—indigenous pot-herbs, wild yams (*Dioscorea*), etc., introduced tropical—okra (*Hibiscus*), egg-plant (*Solanum*), peppers (*Capsicum*) and chayote (*Sechium*) are cultivated. Among temperate vegetables grown at higher altitudes it is interesting to note the potato (*Solanum tuberosum*), many varieties of which have been imported during the last twenty years, mostly from Kenya, and now grown for sale to Europeans and for local native markets. It thrives at elevations of about 6,000 ft.—notably in Bugishu and Kigezi, where the crop yields well and has become an important foodstuff. Tomatoes are extensively produced and onions, shallots, etc., are cultivated on native farms. Cabbages and cauliflower are common in Buganda where they are major market-garden crops. In general it would seem that most European vegetables can be grown at suitable altitudes.

These developments in the production of foodstuffs, especially fresh fruit and vegetables, are of great importance in view of the recent investigations into pellagra—a deficiency disease—carried out by the medical officers in tropical Africa.

The main crops grown on a plantation on a commercial scale are coffee—robusta and Arabian; cacao, para rubber, tea, sugar and tobacco. The fibre plants, cotton and sisal only appear to have reached export standard among other fibres introduced and under trial. The history and development of cotton is given in full under Section viii, pp. 183–288, the importation of varieties for trial beginning about 1903–1910, the industry developing until, as the author states, "Uganda now competes with the Sudan for second place among the cotton producing countries of the British Empire, with a crop lately exceeding 300,000 bales." Sisal—first introduced in 1903—was not grown in commercial plantations until 1929, when an estate was established at Masindi Port, whence in 1936, 1,500 tons were exported. Other fibres that are or have been under trial include Mauritius hemp, sunn hemp and ramie or China grass.

Oil yielding plants (Section xiv) include cotton seed—50,000 tons average for five years (1930–35) shipped from Mombasa. Oil palm (*Elæis guineensis*), a native of West Africa, is also found wild in Uganda near the Congo border. The oil is not exported; but the cultivation is suggested for both pericarp and kernel oils as "a useful addition to native diet, which is poor in fats." Shea butter nut (*Butyrospermum parkii*) is found in the northern parts of Uganda, where the oil from the seeds is used for cooking; but neither nuts nor fat are exported. Tung oil (*Aleurites* spp.) native of China, and candle nut (*Aleurites moluccana*), native of Malaya, are under trial. Lemon grass (*Cymbopogon citratus*), introduced from Kew about 1901, is stated to be the only essential oil plant grown on a commercial scale in Uganda, and other essential oil plants that appear to be still under trial are geranium (*Pelargonium* spp.), patchouli (*Pogostemon* spp.) and vetiver (*Vetiveria zizanioides*). In 1929 a study of all the available essential oil plants was carried out by the botanical and chemical sections and the conclusion they came to was that: "at the present it is unlikely that the commercial production of essential oils will become important in Uganda."

Spices and drugs, native and introduced are discussed in Section xv., pp. 457–466: Of the native spices it is stated: "Few if any of the plants indigenous to Uganda have been used as a source of spice." The introduced plants, mostly under trial except where otherwise stated, are the well-known spices—peppers (chillies or red pepper—*Capsicum* spp.)—naturalized; cinnamon, cloves, turmeric, ginger—well established, but not grown as a commercial crop; and vanilla—cuttings introduced from Ceylon in 1912, now being produced on a commercial scale on a plantation at Entebbe. As to native drugs, there appears to be little information available and those introduced are all more or less under trial: areca nut palm, cocaine plant, quinine bark, wormseed (*Chenopodium*) and *Hydnocarpus* spp.

Included in the same section (xv), tans, dyes, gums and resins are briefly dealt with in less than two pages. The bark of two native trees, *Acacia spirocarpa* and *Terminalia velutina*, is used locally for tanning; wattle bark (*Acacia decurrens* var. *mollis*)—native of Australia, is used by the natives as a wind-break, for building-poles and for fuel in Kigezi, where it has been planted in large quantities but owing, it is said, to high cost of transport, the bark is not exported. Specimen trees of "Tara" (*Caesalpinia spinosa*) and "Divi-divi" (*C. coriaria*) —pods are an important trade tanning material from the Colombian Andes—are under trial. Of dyes it is remarked: "Few native plants have been used to any extent for dyeing for there is no native cloth weaving or fine leather industry as in West Africa." Of gums and resins the author states: "Many native trees produce gums but the trade in such products has never been large." Specimens of various exotic gum and resin producing plants are growing at Entebbe including balata, gutta-percha, chicle gum and benzoin; "all grow quite well but none shows prospect of being commercially important in Uganda."

The final pages of the text treat respectively of "Cover-Crops and Shade Trees", "Fruits and Vegetables" (mentioned in this note under Foods), "Grasses and Grazing"—including "Weeds", "The Marketing of Native Produce" and "Agricultural Education and Extension Work". Excellent indexes to scientific names of plants, of insects and general, conclude the book.

Agriculture at the present time in practically all countries is of paramount importance, especially so in the tropics, whence come many of the raw materials—rubber, fibres, oils, etc.—to quote a few examples only, on which our great manufacturing centres depend. Sisal hemp for example, in its use for binder-twine for harvesting machinery, may mean in every yard of its manufacture the saving of a loaf of bread, and in production and use it probably ranks second to cotton, which is regarded as the world's greatest industrial fibre and the most important of all agricultural products in international trade. When the ruling powers come to take stock of the resources on an international scale after the present world's disturbance of trade and transport, such works as the one now under review, based on many years experience, will not be found wanting.

The authors are to be congratulated on producing a very useful and handy volume, more readily accessible than the official agricultural technical papers and bulletins in which, as stated by the editor in his introduction, "much of the information has been published", and as foreshadowed by him, calculated to "enable those who are interested in the present state of Agriculture in this part of Africa to obtain reliable data quickly".

J. H. HOLLAND.

ESSENTIALS OF INTERVIEWING

The Psychology of the Interview
By R. C. Oldfield. Pp. xv+144. (London: Methuen and Co., Ltd., 1941.) 5*s*. net.

IN recent years psychologists have come increasingly to realize that the proper conduct of an interview is one of their basic techniques, whether it is used for supplementing experiment or as itself the chief tool of inquiry. Some parts of Mr. Oldfield's brief study bear on the psychological nature of interviewing in general, but in spite of its comprehensive title the book is in the main limited to the interviewing of candidates for employment, in itself an important enough topic to justify the closest study.

Part of the book offers sensible practical suggestions as to the setting and conduct of interviews. They represent a pooling of the practice of several experienced interviewers whose methods Mr. Oldfield was allowed to observe. The current practice, however, is not merely recorded but is also assessed from the psychological point of view, and Mr. Oldfield writes with good insight into the social situation created by interviewing. The total picture he presents, familiar though its details are, will be found illuminating even by experienced interviewers.

But Mr. Oldfield's chief interest is clearly theoretical. He is concerned to give an exact psychological description of the processes in which interviewing consists. In the first place he argues convincingly that each interview must remain a unique social situation, manipulated and interpreted by the interviewer according to his personal skill and intuitive insight. That is to say, the interview must be an achievement of personal craftsmanship and cannot be turned into a standardized experimental situation in which the only variable is the candidate. This is probably true of the type of interview Mr. Oldfield is discussing, where conversation is relied on almost exclusively, but it may need to be slightly modified if one considers interviews where the candidate's approach to standardized tasks, such as performance tests of intelligence, is systematically observed for the light it throws on temperamental qualities.

A useful theoretical contribution is the insistence that conversation, the texture of the interview, consists in a mutual modification or manipulation of attitudes, and that the exchange of information and specific opinions is only subsidiary, a means to the evocation of attitudes. This is in line with the growing recognition that the relative importance of cognitive experience and verbal behaviour has for long been exaggerated. Mr. Oldfield's view, however, is in danger of becoming too abstract to be useful when he reduces the interviewer's entire activity to the evocation and perception of attitudes in the candidate. This view of the matter cannot be said to be untrue, since all human activity expresses itself in a sequence of attitudes. But it ignores the important question of what feature of the candidate's personality a given attitude chiefly reflects ; whether, for example, a broad temperamental quality or a particular sentiment. The importance of interests is also rather slighted. Interests, temperamental qualities and sentiments are obviously closely connected and, of course, reveal themselves in attitudes, but they must be distinguished if the interviewer is to understand the significance of the attitudes he perceives in a candidate.

Although Mr. Oldfield's conclusions are not to be accepted without qualification, his effort towards a radical understanding of the interview as a psychological tool is nevertheless of very real value.

A BIRD OBSERVER IN CORNWALL

Winged Company
Studies in Bird-Watching. By R. G. Walmsley. Pp. xiii+227. (London : Eyre and Spottiswoode, Ltd., 1940.) 7*s.* 6*d.* net.

IT is a coincidence that I should be able to review this attractive bird book, because, not long before his death, the author wrote to me. In his letter he mentioned that he had been reading a book, "Wild Birds in Britain", which I had written about that time, and he had been, he said, greatly impressed by the resemblance between that book and the manuscript he had written. He said he felt that he might well have been the author of my book, and he felt he must write and tell me this lest, if ever his manuscript should appear in print (he was very doubtful of this at the time) I should know that he had not been copying my own style and treatment of the subject.

"Winged Company" is written by a true lover of birds, for as with Edward Grey of Falloden, birds were his great joy during the last years of his life. The birds he watched so lovingly, and with such accuracy, were mainly observed in Cornwall. Raven and chough, peregrine and buzzard, gannet and kittiwake, shearwaters and terns, and the tribe of the divers, among the larger species ; redwing and fieldfare, wheatear and skylark, the tribe of the warblers and the clan of the buntings among the smaller species. I was interested to read the author's statement that willow warblers "take a particular pleasure in tormenting Long Tailed Tits : they are like mischievous little boys chasing a party of fussy old ladies". I wonder if other observers have noted this.

He loved the wood warbler, which arrives "at a time when the beech leaves are most silky and diaphanous and the woods are filled with cool green lucencies". But surely the colour "beneath the wings of the Redwing" is not "scarlet" but rather cinnamon (p. 65). It is interesting to know (p. 70) that the first wheatear arrives on the Cornish coast during the first days of March. In the Isle of Skye it is the last week in that month before he is seen (the males always arrive first). I write this notice on April 12, yet I have seen no wheatear, and were he here he would be shivering under the lashings of an Arctic wind. I like the author's description of the male wheatear (p. 70):

> "The male Wheatears at this period are brilliantly arrayed ; pearl-grey, black, white, and a tint somewhere between salmon and apricot blend to produce a plumage of exotic beauty. . . . There is surely something Egyptian in the Wheatear's expression, a suggestion reinforced by its colouring, by the black and white fan of its tail, and by the bird's strange instinct toward the sand."

This book is one which will appeal to all those who love birds. The author's style is direct, simple, and bears distinction. For war-time days of paper shortage it is admirably reproduced. It is indeed a book to be read slowly, at leisure, to be fully appreciated, and the more one studies the wood-cuts by Denys Watkins-Pitchford, which form the illustrations, the more one is impressed by their accuracy. I like especially that showing buzzards circling over Zennor Cliffs (p. 195), but that of the peregrine's stoop at Rock Doves (p. 201) is fully its equal, and shows minuteness of observation and delicacy of delineation.

SETON GORDON.

PLANKTON AS A SOURCE OF FOOD

By Prof. A. C. Hardy, F.R.S.
University College, Hull

SIR JOHN GRAHAM KERR recently asked a question in the House of Commons and wrote a letter to *The Times*[1] proposing that a committee of biologists and engineers should be instituted to inquire into the possibility of obtaining food direct from the marine plankton.

One of the most surprising results of the "Discovery" investigations was the demonstration by Mackintosh and Wheeler[2] that the great rorquals, the Blue and Fin whales, became sexually mature and reach an average length of 75 ft. and 65 ft. respectively in *only two years* from birth; they are born 23 ft. and 21 ft. long after some eleven months of fœtal life. This prodigious mammalian growth, including the formation of great food reserves in the blubber, is built up entirely on a planktonic diet. It would certainly appear worth while to inquire if some of this wealth of food could not be taken directly from the sea to be used, if not for human consumption, as a valuable addition to the food of stock.

It is just fifty years since the late Sir William Herdman described in NATURE[3] how plankton formed a breakfast dish for a yachting party of eight. Johnstone[4] gives the following composition of the dry substance of copepod plankton: protein 59 per cent, fat 7 per cent, carbohydrate 20 per cent, chitin 4·7 per cent and ash 9·3 per cent. Gunther[5] found the oil content of zooplankton collected from the Isle of Man to vary between 15·05 and 19·3 per cent of dry weight.

No doubt a good deal of preliminary work would have to be done to see if the yield would be sufficient to warrant the cost of power and labour in its harvesting and preparation. Even if it was not an economic proposition for peace-time, the urgent need for food in war-time might put the matter in quite a different light.

Dr. George Clarke, of the Woods Hole Oceanographic Institution, wrote an article on the subject just before the War[6]. "According to a recent news report", he writes, "the German State Biological Institute at Heligoland is investigating the possibility of harvesting the plankton of the sea as a new food source for the German market to make Germany still more independent of foreign imports. Zooplankton was reported to have a nutritive value equivalent to the best meat and phytoplankton to be equal to rye flour."

Clarke considers that one might take "as an outside figure" a value of 0·1 gm. dry weight of plankton per cubic metre of sea water and that 750 gm. would be required to support one man per day assuming all the organic matter in the plankton to be assimilable. On this basis "each member of the population would require all the zooplankton from *at least* 7,500 cubic metres each day . . . . Using the largest net generally found practical (2 m. in diameter) at a fast towing speed (2 knots) and assuming a 20 per cent straining efficiency for a coarse net, a period of 2½ hours would be necessary to filter this volume of water. If several nets were used simultaneously, more men and larger boats entailing greater operating costs would be required." He ends his article by saying: "We are forced to conclude, therefore, that if the marketing of plankton on a commercial scale is to become a practical reality, either areas of greatly increased richness must be located or some method must be found for making the above rate of procuring plankton economically feasible."

Clarke's view of the matter might indeed have appeared discouraging had he not added the following footnote: "There might be some possibility of operating economically a filtering plant in a tidal flow between suitably located islands or in the entrance of an estuary." Here may well be the starting-point for such an experiment; if it should be successful, we, in the British Isles, are extraordinarily well placed for such an enterprise.

Up the west coast of Scotland there is an exceptionally rich plankton, richer than that upon which Clarke based his calculations, a plankton which supports the shoals of Loch Fyne herrings, attracts the basking sharks to the Firth of Clyde and has fed the rorquals which in years past made a whaling station in the Hebrides a paying proposition. In many of the long sea lochs, teeming with plankton, there is a strong tidal flow. In English estuaries huge tidal 'filter nets' have been used successfully by fishermen for generations. The sprat and whitebait fishermen of the Thames Estuary use 'stow nets' 200 ft. in length and having an opening of 20 ft. × 30 ft.; each net is streamed below a boat at anchor and is fastened by its bridles to the anchor chain. In the Bristol Channel (at Weston-super-Mare and Clevedon) nets with an opening 18 ft. square are streamed from the anchor chains of buoys so that they will swing as the tide turns. These nets are described in detail in that fascinating work, "An Account of the Fishing Gear of England and Wales"[7], by the late Mr. F. M. Davis.

A swing net such as the last mentioned could be made of stramin (a strong openly woven fabric in common use for the collection of the larger zooplankton) supported by the application of longitudinal and transverse lengths of rope. It would have an opening of 30 square metres. Taking Clarke's estimate of a filtering efficiency of 20 per cent, it would filter 22,278 cubic metres of sea water per hour in a 2-knot tide way. The pressure on the net could be reduced by fitting a conical opening to the entrance of the net to cut down the water entering to suit its filtering efficiency, as in Hensen's plankton net. It could swing with the tide and fish in both the flow and the ebb. The 'cod-end' could be hauled up and emptied of the catch at slack water by two men in a small boat. In many positions in the Scottish sea lochs one could count on the equivalent of a tidal flow averaging 2 knots for at least 12 hours a day. The net could be fished near the surface at night and deeper during the day to accord with the diurnal vertical migration of the bulk of the zooplankton. It could be made to turn and fish inside out and so be reversed at each emptying of the cod-end in order to prevent the meshes becoming clogged, as they would if it were constantly used in one direction.

Ten such nets fishing for 12 hours would yield 267·3 kgm., or 5¼ cwt., *dry weight* of plankton a day, or enough to feed 357 people. It would seem likely that the very rich plankton off the west of Scotland might give an even higher yield than this, which is based on Clarke's estimate of 0·1 gm. dry weight of plankton per cubic metre of sea water.

If tests for yield could be made this summer with a few such nets placed at different points in the Scottish sea lochs and if at the same time researches were undertaken into the food values of the plankton and the best means of making it available for either human or animal consumption we might in time for next summer know if it would be worth while launching a large-scale effort to increase the country's food supply.

More than a thousand miles of drift nets were used in our herring fishery in the days of its prime. The herring grounds are now largely closed and the boats and crews otherwise employed. If trials were found to justify the above calculations, a hundred 'fleets' of tidal nets (each of ten nets looked after by two men) would yield 26¼ tons of plankton *dry weight* per day from the sheltered waters comparatively safe from enemy action. The plankton could be transported by boat or road to factories for its treatment at suitable points along the coast. Such a war-time emergency measure might well give rise to a regular peace-time industry. With practice the efficiency of the methods could be increased and perhaps in time it would be economically feasible to employ special ships to harvest the still richer plankton of the polar seas.

Sir John Graham Kerr's request that a committee should be set up by the Ministry of Food to inquire into the possibility of obtaining food from the plankton should not lightly be turned aside. In his question in the House of Commons he referred to modern types of mechanical separators; it would be important to investigate whether these would be more economical and efficient than the use of tidal nets.

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[1] *The Times*, May 6, 1941.

[2] Mackintosh, N. A., and Wheeler, J. F. G., *Discovery Reports*, **1**, 259 (1929).

[3] Herdman, Sir William, NATURE, **44**, 273 (1891).

[4] Johnstone, J., "Conditions of Life in the Sea", Cambridge (1908).

[5] Gunther, E. R., *J. Exp. Biol.*, **11**, 192 (1934).

[6] Clarke, G. L., *Science*, **89**, 602 (1939).

[7] Davis, F. M., Min. of Agric. and Fisheries, Fishery Investigations, Series II, 15, No. 2 (1936).

NATURE OF THE INTRAMOLECULAR FOLD IN ALPHA-KERATIN AND ALPHA-MYOSIN

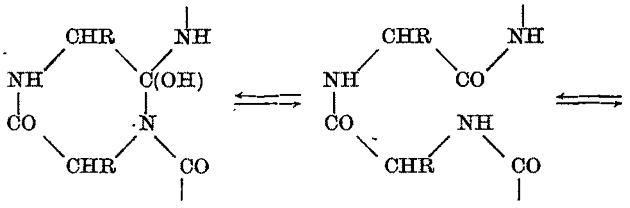
By Dr. W. T. Astbury, F.R.S., and Dr. Florence O. Bell,

Textile Physics Laboratory, University of Leeds

KERATIN, the protein of mammalian hairs and related epidermal tissues, the fibrous proteins of the epidermis itself, and myosin[2], the principal protein of muscle tissue, all fall into one great group of fibrous proteins that have a common molecular configuration and similar long-range elastic properties. This generalization follows from a series of X-ray and supporting investigations that have been described among other places in NATURE[1]. There will perhaps be no need then to summarize them again here, beyond recalling that the structural unit of the group is a 'grid' consisting of long polypeptide chains cross-linked by means of their side-chains, that the main-chains of this grid are not normally in the extended configuration but are thrown into a sequence of folds transverse to the side-chains, and that when the fibres are stretched the grid is pulled out flat, only to return to its folded configuration when the tension is released. The normal folded configuration we have called α, the extended configuration β, and the reversible intramolecular transformation from α-keratin (or α-myosin) to β-keratin (or β-myosin) is the basis of the remarkable long-range elastic properties of this group of protein fibres.

The chemical constitution of the group changes unmistakably as we pass from keratin on one hand to myosin on the other, though the main features (not the fine structure) of the X-ray diffraction pattern remain always the same, especially the strong meridian reflexion of spacing about 5·1 A. Even without the confirmatory evidence of the elastic and other properties, this is sufficient to demonstrate convincingly that there is some intramolecular conformation common to the whole group, something analogous to the benzene ring, say, in aromatic chemistry, that overrides within limits variations in empirical constitution. The implication, of course, is that the conformation in question is the intramolecular fold responsible for the long-range elastic properties, and it is a matter of stereochemical urgency, for the great keratin-myosin group in particular and for proteins in general, to discover its exact nature.

Our earlier theory was that the transformation involves the opening of hexagonal rings, thus :



ALPHA

and more recently Wrinch has developed the same idea systematically into her 'cyclol hypothesis'. But now the tide of evidence is flowing strongly against it [3, 4], and especially the experiments of Neurath[5] with up-to-date scale models have shown conclusively that there is simply no room for the side-chains when the main-chains are folded in this way. It seems that we have to accept the fact once and for all and bend ourselves to seek a new solution.

The β-configuration may be represented diagrammatically as in Fig. 1. There is no stereochemical difficulty about it; the side-chains lie alternately on one side and the other of the main-chain, well out of one another's way. The unstretched, or α-, configuration is formed from the β- by throwing the main-chains into a series of regular folds (in terms of Fig. 1 these folds undulate above and below the plane of the paper), and the operations of extension and contraction leave the integrity of the grid unchanged.

Now put as concisely as possible, the experimental and general structural conditions[6] to be satisfied by the α-β transformation are as follows :

(1) The α-form must be about half as long as the β-form.

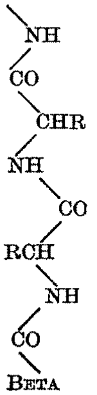
(2) The density must remain practically constant.

(3) The folds must repeat at a distance of about 5·1A.

(4) The side-chains must stand out alternately on one side and the other of the plane of the fold.

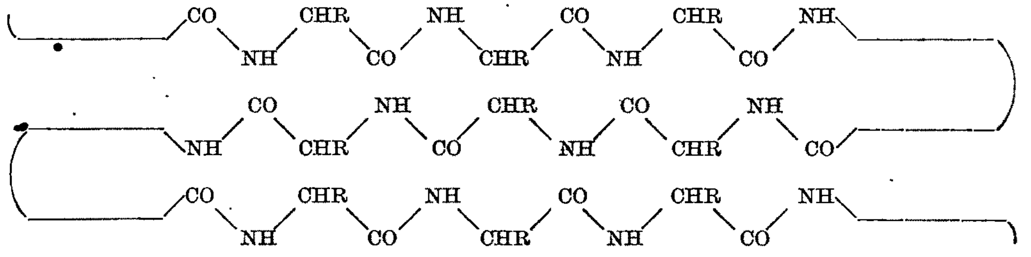
(5) The folds must be nowhere so sharp as to leave insufficient room for the side-chains.

Is it feasible to devise an intramolecular fold satisfying all these conditions that could conceivably, pending complete chemical analyses, be adapted equally well to the constitution of myosin as to that of keratin ? We believe that it is ; and what is more, the proposed solution hints at a principle fundamental for all proteins.



BETA

Consider condition (2). It is really nothing new or unique, for almost all proteins have densities in the neighbourhood of 1·3, the density of wool keratin. This order of density is what we should expect for a parallel polypeptide chain system in the β-configuration[7], and the fact of its being observed again in the corpuscular (or globular) proteins, both before and after denaturation[8], provides one of the best arguments we have in favour of regarding these proteins also as effectively fibrous. The inference is that folds in polypeptides are in general of the following type[9] :



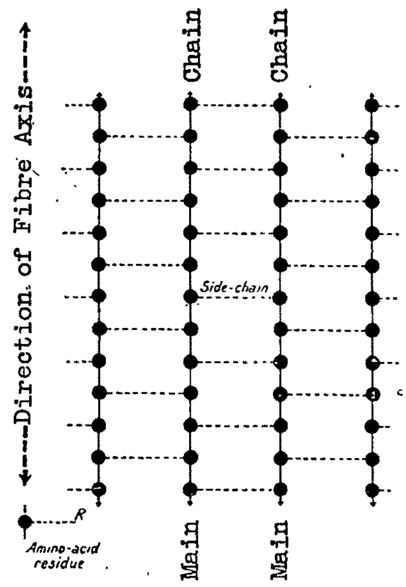


Fig. 1.

A POLYPEPTIDE 'GRID' IN THE β-CONFIGURATION.

with the side-chains projecting alternately above and below the plane of the folds.

If now we try in this way to accommodate the other conditions, we find at once with the aid of models that 5·1 A. *is just about the shortest distance at which it is possible to fold a polypeptide chain so as to leave the side-chains alternately on one side and the other of the fold*, and further of course, if the fold is approximately square, it doubles its length too when opened out. We have thus satisfied the first four conditions, and there remains only to examine more closely the fate of the fifth. Actually, *the side-chains are seen to be grouped in close-packed triangular columns first on one side of the fold and then on the other.*

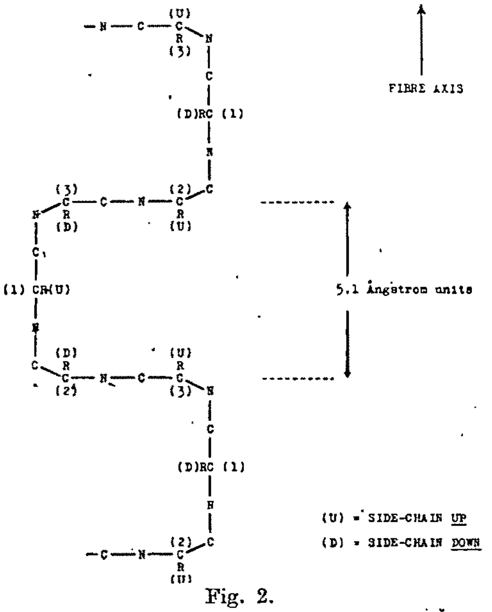


Fig. 2.

PROPOSED BASIS OF THE INTRAMOLECULAR FOLD IN α-KERATIN AND α-MYOSIN.

The sequence of amino acid residues and the inter-relations of the side-chains are shown diagrammatically in Figs. 2 and 3, while Figs. 4*a* and 4*b* are photographs of an atomic model, built to scale[10], of one fold and part of the fold adjacent to it. In Fig. 4*a*, which illustrates the packing of the side-chains and corresponds to that part of Fig. 3 surrounded by a dotted line, the large spheres represent the second CH_2-group counting from the main-chain (assuming for our purpose side-chains at least two carbon atoms long), but in Fig. 4*b*, the other face of the model, the side-chains have been removed to reveal the form of the main-chain. The diagrammatic square has been distorted somewhat so as to build a 'hydrogen bridge' between opposing CO- and NH-groups within the fold, and it has also been found necessary, in order to meet the dimensional requirements of the X-ray photographs, to postulate hydrogen bridges between adjacent folds. Altogether, the arrangement seems very satisfactory indeed—in fact the various atoms and groups fit together so neatly that it is scarcely possible to construct the model in any other way if the five basic conditions are to be observed. A particularly nice point is this, that the shortest permissible width of fold is rather greater than the distance of closest packing of alkyl chains, and therefore the tendency to close packing is slightly in excess of what we need: conceivably it could fold the backbone a little tighter still, but the bounds are set just before that—and so the *main* pattern always repeats at the same distance, 5·1 A. As soon as the side-chains leave the confines of the backbone they presumably cling together rather more closely, and if they want to open out again

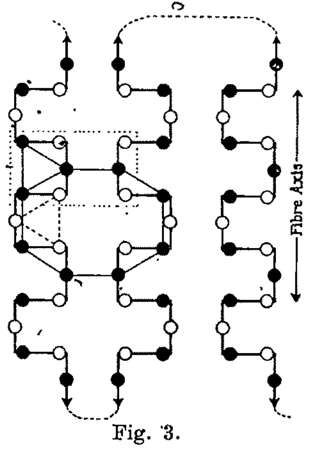


Fig. 3.

ILLUSTRATING THE CLOSE PACKING OF SIDE-CHAINS IN THE α-FOLD OF KERATIN AND MYOSIN.

—represents the direction of the main-chain; ● represents a side-chain pointing *up* from the plane of the diagram; ○ represents a side-chain pointing *down* from the plane of the diagram.

somewhat to allow for the bulkier of the terminal groups, they can do so by making use of the octagonal gaps in the structure (see Fig. 3).

The above solution of the keratin-myosin problem has been obtained by induction, but the more correct treatment would appear to be by *deduction* from the principle of close packing. The principle is familiar enough in structures built from ions and small molecules, but it must apply also to the mobile parts of single large molecules, such as the side-chains in proteins. We should like to put it forward here, in fact, as probably one of the great general principles of protein structure. It leads immediately, for example, to the present solution of the keratin-myosin problem, for obviously the arrangement shown in Fig. 3 is one of the first we should arrive at. No longer need we be surprised at the remarkable 'accident' that β-keratin is just about twice as long as α-keratin and has just about the same density: we see now that *these supposed conditions are inevitable consequences of close-packing the side-chains in a simple, regular pattern.*

The accompanying table summarizes the comparative chemical constitutions of wool keratin and rabbit myosin as derived with the help of X-ray data in the manner already described in this journal[11]. The table is frankly idealistic, incomplete and tentative in parts[12]; but in any event it is obvious that the two proteins differ considerably in empirical constitution. There must therefore be a certain interchangeability, or rather potential interchangeability, between the residues forming one structure and those forming the other, an intramolecular counterpart of mixed crystallization[11]. Provided a residue is of the right 'type', apparently that is all that matters, within limits.

COMPARATIVE CHEMICAL CONSTITUTIONS OF KERATIN AND MYOSIN

Amino acid	Proposed numbers of residues of each amino acid in a total of 576	
	Wool keratin	Rabbit myosin
Glycine	64	48 (?)
Alanine	32	48
Valine	24	24
Leucine, etc.	64	64
Phenylalanine	16	16
Proline	36 (or 32)	3
Methionine	3	16
Cystine/2	72 (or 64)	8
Serine	64	48 (?)
Threonine	32	48 (?)
Tyrosine	16	18 (?)
Tryptophane	6	3
Aspartic acid	32	48
Glutamic acid	64	96
Arginine	36 (or 48)	32
Lysine	12	48
Histidine	3	8
Totals	576	576
Residues as amides	64	64
Average residue weight	118	116 approx.
Molecular weight	68,000	67,000

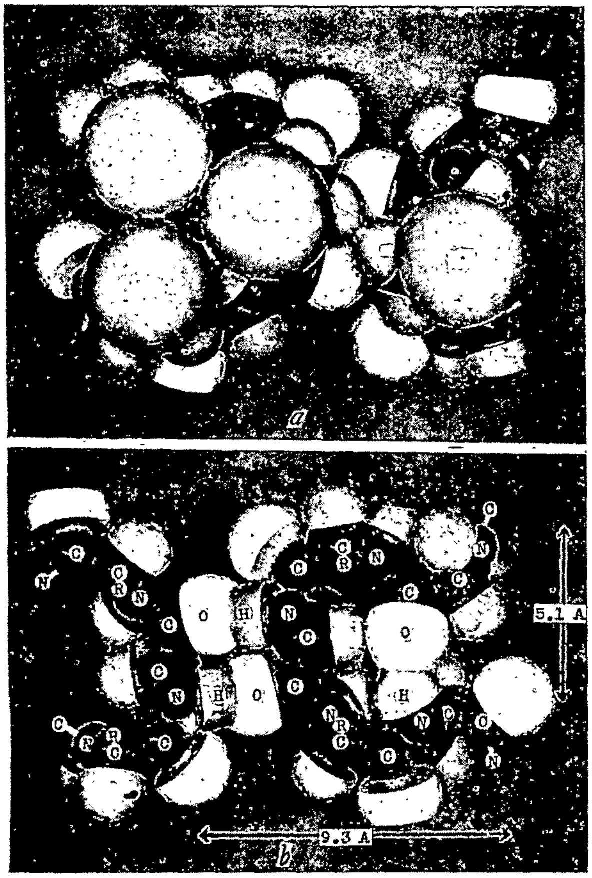


Fig. 4.

The great lesson of the keratin-myosin group is that a protein is essentially a pattern of charges associated with a close-packed forest of side-chains, the polypeptide chain being an infinitely variable device for building up distributions of charges and presenting them to given chemical environments. A typical, though not necessarily universal, unit of protein architecture is a sheet (or ribbon) of folded main-chains with side-chains projecting from either face. Several years ago (also in the pages of this journal) we gave strong reasons for supposing that the native egg albumin molecule consists of four such sheets superposed[13]. The further developments of the keratin-myosin theory outlined in this article only tend to confirm the suggestion.

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[1] See also Astbury, W. T., Jubilee Memorial Lecture of the Society of Chemical Industry, *Chem. and Ind.* (in press), and **60**, 41 (1941).

[2] Astbury, W. T., and Dickinson S. *Proc. Roy. Soc.*, B, **129**, 307 (1940).

[3] Pauling, L., and Niemann, C., *J. Amer. Chem. Soc.*, **61**, 1860 (1939).

[4] Astbury, W. T., *Trans. Faraday Soc.*, **36**, 871 (1940).

[5] Neurath, H., *J. Phys. Chem.*, **44**, 296 (1940).

[6] Astbury, W. T., and Street, A., *Phil. Trans. Roy. Soc.*, A, **230**, 75 (1931); Astbury, W. T., and Woods, H. J., *ibid.*, A, **232**, 333 (1933); Astbury, W. T., and Sisson, W. A., *Proc. Roy. Soc.*, A, **150**, 533 (1935); Astbury, W. T., *J. Text. Inst.*, **27**, P282 (1936); Woods, H. J., *Proc. Roy. Soc.*, A, **166**; 76 (1938).

[7] Astbury, W. T., *Trans. Faraday Soc.*, **29**, 193 (1933).

[8] See, for example, Bull, H. B., Cold Spring Harbor Symposia on Quantitative Biology, **6**, 140 (1938).

[9] Astbury, W. T., Dickinson, S., and Bailey, K., *Biochem. J.*, **29**, 2351 (1935).

[10] Pauling, L., "The Nature of the Chemical Bond" (1939).

[11] Astbury, W. T., NATURE, **140**, 968 (1937); Astbury, W. T., and Bell, F. O., Cold Spring Harbor Symposia on Quantitative Biology, **6**, 109 (1938).

[12] A full discussion will be given elsewhere. In the meantime, we should like to make it clear that no responsibility for the precise residue numbers chosen attaches to the protein analysts whose experimental results have been utilized.

[13] Astbury, W. T., NATURE, **137**, 803 (1936). Pauling has recently put forward a similar suggestion in *J. Amer. Chem. Soc*,. **62**, 2643, (1940)).

THE CIVILIAN POPULATION UNDER BOMBARDMENT

BY R. J. BARTLETT,

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A MEETING of the British Psychological Society was held at Nottingham during April 17–21 and, among other matters, dealt with the effects of war conditions on the civilian population. In particular, Dr. Margaret Lowenfeld introduced the problem of man in the mass, while Dr. H. Crichton-Miller set out the effects on the individual of air bombardment. Discussion emphasized that more should be done by psychologists in air-raid shelters and evacuation areas, and a further meeting will be held to consider the whole situation.

Man in the aggregate shows behaviour that cannot be foretold from the study of man as an individual; but there is little that ranks as scientific knowledge of such behaviour. Many assumptions about mass behaviour derive from introspection, the study of animal behaviour and from psychopathology. The inadequacy of such a basis is witnessed by the breakdown of the theory that, brought to its senses by the horrors and foolishness of 1914–18, mankind would replace savage war by civilized consultation; and by the fact that loudly heralded 'panic' has, so far, failed to materialize.

There is scarcely any acceptable published material on which to base decisions of such practical importance as the kind of shelters human beings prefer: whether deep or surface, noisy or quiet, small or large. We do not know the conditions that promote or hinder courage, or how best to protect children. We do know that groups of the population behave peculiarly; that in some areas old men and women refuse removal to safety from nightly bombardment, that panic does not occur where physiologically it should, and that noise is more frightening than bomb destruction to some, while it is comforting to others.

With the same people nightly in the same shelters, subjected to events varying from mere boredom to the horrors of an inferno, almost laboratory conditions are provided for testing theories of instinctive activity and volitional control. Such an opportunity ought not to be neglected by social psychology. Concerted effort should be made to secure unbiased psychological truth and to put it to practical use. It is time that factually based reasoning and planning were given a chance to displace 'trial and error' methods.

The official explanation of absence of panic under bombardment and presence of the 'we can take it' attitude would seem to be our much-applauded morale. Therein lies a danger. Moral courage eliminates self-pity and malingering, and, if functional disability is due to these, it is something to be ashamed of and despised. But functional disability resulting from air bombardment is a serious reality and has nothing whatever to do with morals. In the War of 1914–18 the functional effects of high explosives were clearly recognized and labelled shell-shock. For various reasons it was decided to cut out shell-shock from the present War. However, the naïve conviction that a symptom can be eliminated by forbidding it a name broke down. The symptom reappeared and clinicians named it blast-concussion.

The incalculable effect of blast on plate-glass windows is a commonplace. It is reasonable to suppose that similar effects of compression and suction on elastic abdominal walls displace the fluids of the body with extreme violence to and from the skull-contained brain. The strain thus imposed upon the delicate structure of the central nervous system is very severe and in fatal cases punctate hæmorrhages are found, *post mortem*, not only in the meninges but also throughout the brain substance.

Blast-concussion, in varying degrees of severity, is to be expected after exposure to an explosion. It bears no relation to morale, courage, discipline or any other ethical virtue, and has no intrinsic connexion with psychology. Extrinsic association is, however, very common. The effects on a person suffering from acute anxiety differ from those on one knocked out with 'no time to be frightened'. A hysterical person will exploit the effects in the same unconscious or semi-volitional way in which other disabilities are exploited. An alloy of organic concussion and emotional fear is common. Each factor should be dealt with, and the assumption that all unwounded patients are malingerers should be carefully avoided. The obviously wounded person is in a relatively happy position. He is ensured the rest essential for cure of concussion, and spared the feeling of loss of prestige from being disabled without visible trauma. Thus the worst effects of blast-concussion are seen in the unwounded.

Consider next physiological conditions influencing air-raid reactions. An exhausted man, with his supply of blood sugar at fasting level or below it, reacts badly to fear of death or danger. Anæmia and anoxæmia lead to despondency, apathy and inertia on one hand and to mental confusion and uncontrolled behaviour on the other. Toxæmia lowers the whole resistance of the organism. With women there is also the varying emotional effects of the menstrual cycle, lactation and the climacteric. Again, in reaction to fear there is the influence of the adrenal glands. Normally fear produces an adrenal response which mobilizes available glucose, increasing muscular tone and enhancing activity which issues in 'fight or flight'. In troops about to attack, aggression should be at a maximum; but with civilians exposed to bombardment the natural reactions of 'fight or flight' are inappropriate, and fortitude, endurance, self-control are needed. In the first we have an instinctive pattern of behaviour, in the second a civilized pattern of conduct. In the absence of opportunity for retaliation or escape a severe strain is placed upon the efficiency of cortical control. Fear of death or suffering is endured in a latent or overt way. If latent it constitutes anxiety, if expressed we call it hysteria. The hysterical appeal drains off anxiety which has been accumulated by interference with the 'fight or flight' mechanism. Anxiety is the price man pays for a culture that demands inhibition of fear and hate reactions.

All this can be seen in the shelter situation under bombardment. Crude pugnacity in one man picks a quarrel with the shelter warden on wholly inadequate grounds. Flight reaction in another refuses the protection of the shelter and drives away, on and on, until the petrol supply is exhausted. In either case the breakdown of cortical control results in an instinctive reaction to fear. With realization that neither fight nor flight is a reasonable way out, the anxiety case, trembling and sweating, alert, taut and incapable of relaxation, scarcely controls himself as explosion follows explosion, while the hysteric in many ways proclaims the need of compassion, admiration or interest, and takes refuge in imagined protection of others. Still more common is anxiety-hysteria in which a limited control is unable to restrain a partial publicity campaign, but, nevertheless, succeeds in enduring a measure of unrelieved fear.

In many cases no one factor will fully account for the unhappy condition of the patient. A case was quoted where the recognized causes were: (1) dental sepsis, (2) gross ill treatment in childhood, (3) unfaithful marital life charged with guilt and fear. The elimination of any one of these factors would have modified the character of the breakdown. Each played its part in reducing a powerfully built, athletic man to a trembling, sighing, restless mass of anxiety when his house was demolished just after he and his family had taken cover in a public shelter.

OBITUARIES

Dr. Otto Pettersson

OTTO PETTERSSON, chemist, physicist and hydrographer, was born in Gothenburg in February 1848, and died there on January 16, 1941. He took his degree at Uppsala in 1882, and began work as an inorganic chemist, studying selenium and beryllium while his friend Theodor Cleve was studying the rare earths; but he soon turned to physical chemistry, which was coming to the front just then, and had a long paper in NATURE on a "New Principle of Measuring Heat", in 1884, nearly sixty years ago (NATURE, **30**, 320; 1884). Heat phenomena in general, specific heats, latent heats and heats of crystallization, led him towards hydrography by way of the temperature and ice-conditions of the Baltic and Arctic Seas; and he got his chance when Nordenskiöld brought the *Vega* home and asked him to report on the hydrography of the Siberian Sea. A careful determination of the maximal density-point of sea-water at various salinities formed part of this report, and the work brought him into contact with John Murray, and with Tait, who was then busy with the temperature observations of the *Challenger*.

Pettersson had a family place at Holma, in Bohuslan, where the Baltic was at his very door, with all its fascinating hydrography. F. L. Ekman had made a good start towards its investigation, but there was plenty left to do; and Pettersson with his friend, Gustav Ekman, wrote one paper after another in the early 'nineties, mostly on the hydrography of the Skagerrak. Two problems interested him then and ever after. Where ocean water enters the inland sea it dips down and lets the fresh water float out above the salt; each has its own phenomena, and the submerged surface of discontinuity is the seat of waves and tides which may reach considerable amplitude. Under such conditions as these Nansen had encountered 'dead water', and Wilfred Ekman had explained that old mystery once for all; our submarine commanders were mightily perplexed by the same stratification when they first entered the Skagerrak in the beginning of the War of 1914–18; and here Otto Pettersson found what he called the Gulf-stream water' rolling in, deep down, invisible.

The second problem, closely associated with the first, lay in the vicissitudes of the Swedish herring fishery. For Bohuslan had been the seat of the great Hanseatic herring fishery in the thirteenth and fourteenth centuries, until it came to a sudden end in the fifteenth, and moved out, to the enrichment of Holland, into the North Sea. Pettersson found an explanation of this great historical event (and of certain other catastrophies such as the formation of the Zuyder Zee) as part of a long-period phenomenon, due to hydrographical and, in turn, to astronomical tide-producing conditions. At a certain rare configuration of sun and moon, he said, great underwaves rolled into the Baltic from the ocean, and brought the herring where they now no longer come. At the same time the fresh waters were reduced to a shallow surface-layer, so apt to cool down and freeze that severe winters and a frozen Baltic were a common thing. All this work of Pettersson's is extraordinarily interesting; but it is very complex and very difficult, and perhaps the time has not yet come to judge it.

Pettersson and his friends were pioneers of oceanography, and it was they who brought a little company together in Stockholm, in 1899, to plan the international "Exploration of the Sea". Nansen was there, and John Murray and Otto Krümmel; Cleve was there, once a famous chemist, now one of the chief students of the micro-fauna of the surface of the sea; Gustav Ekman came from Gothenburg and Victor Hensen from Kiel and Friedrich Heincke from Heligoland; and Johann Hjort and Martin Knudsen and I who write these lines were among the younger men. It was an honour and an education to be there.

Otto Pettersson lived two happy lives, as farmer and as scientific man. "I am a peasant," he was wont to say; it was the only English word he ever mispronounced. When I once paid him a visit at Holma he had some sixty or seventy beautiful Frisian cows in his model dairy, and he had lately built his laboratory on a little rocky island just over the way. The cliff went sheer down, and the workroom actually overhung the deep water of the Gulmarfjord. The little place was full of gadgets; water could be pumped from various depths, and all sorts of recording instruments ticked away. A copper vessel floating on the surface of discontinuity rose and fell with the submarine waves, and transmitted their motion to a recording drum. In fact, the devising of apparatus was one of Pettersson's special gifts, perhaps his greatest gift of all; the water-bottle which goes by his name and Nansen's was really his. Nansen, for all I know, may have somewhat improved it, and he used it and made it known; but it was Otto Pettersson who made it first, and gave it to Nansen to take with him on the *Fram*. Pettersson was fertile of ideas, ingenious in experiment, enthusiastic over all he took in hand to do. Age did not wither him. He kept his sturdy frame, his active mind, his warm heart, his cheerful countenance, even to extreme old age.

D'ARCY W. THOMPSON.

Mr. Francis Druce

MR. FRANCIS DRUCE, who was killed recently by enemy action, was well known as a botanist and collector of botanical books. He was born on January 3, 1873. Educated at Harrow and Magdalen College, Oxford, he entered the long-established firm of Druce and Attlee. In 1910 he was forced by ill-health to retire from active participation in the business (from which he completely retired in 1923), and his great love of "Nature in all her moods" led his energies into the study first of meteorology, then of his chief interest, botany. His legal experience, good judgment and methodical habits made him an ideal treasurer of scientific societies to which he belonged. In this capacity he served the Royal Meteorological Society for two periods, 1913–1918 and 1925–1932. He was treasurer of the Linnean Society of London from 1931 until the autumn of 1940, when he became master of the Innholders' Company, of which, following the family tradition, he had previously been clerk for some years. Of the Botanical Society of the British Isles he became treasurer a few years before his death, and also took over the secretaryship when the secretary was called up for active service.

Druce formed extensive meteorological and botanical libraries. The former he presented to the Royal Meteorological Society some seven years ago, but he continued meteorological observations until his death, and when travelling always carried with him a maximum-minimum thermometer. His botanical library, except for most of his rarer herbals, was in great part destroyed in the fire which followed his death: it has been the subject of an article in the "Private Libraries" series of the Times Literary Supplement (Dec. 31, 1938). His herbarium, which mainly consisted of British plants collected by himself during the past twenty-five years, and which included almost every British species which it is possible at the present time to see in native haunts, was completely destroyed. Since 1919 I have visited most parts of the British Isles in his company, hunting rare desiderata, these ultimately becoming reduced to the 'forlorn hopes' of almost or quite extinct species. He was intrepid on rocks, and appeared quite comfortable standing on the edge of a cliff examining the slopes below through his field-glasses, which he generally carried to observe birds, of whose song (as also of good music) he was a great lover. He acquired a very good knowledge of the British flora and had a good eye for plants, although he himself never tackled any of the critical genera and preferred others to write up the results of his expeditions. He remained unmarried, but took great interest in the boys' clubs of his parish church in Chelsea, of which he was a strong supporter. Generous and loyal, he will be missed by a wide circle of friends.

A. J. WILMOTT.

Dr. C. G. Lamb

WE regret to record the death of Dr. Charles George Lamb, emeritus reader in electrical engineering in the University of Cambridge, on May 4.

Born in 1867, Lamb originally wished to become a professional musician; when the early death of his father made this impracticable, he went to the University of London, where he attended courses on zoology, and for a time contemplated a medical career; but he ultimately decided to study electrical engineering at the City and Guilds College, where as a student he helped to test the first alternating current transformer that was brought to Great Britain. After graduating, Lamb went to Cambridge in 1891 to assist the late Sir Alfred Ewing in his researches on the magnetic properties of iron; in the same year he was appointed University demonstrator in mechanism and applied mechanics, a post which he held until he was appointed University lecturer in electrical engineering in 1903.

During the War of 1914–18, Lamb acted as head of the Department of Engineering; and thereafter, in 1921, the post of reader in electrical engineering was created for him, and ceased to exist on his retirement from reasons of health, in 1931. During the forty years he was teaching in Cambridge, Lamb watched and helped the growth of the Engineering Laboratory from insignificant beginnings to one of the largest departments of the University, and he is remembered with gratitude and affection by generations of students.

One of Lamb's distinguishing characteristics was his versatility; his interests and knowledge of matters remote from his own particular work were astonishingly wide. He could hold his own in discussions on such diverse matters as history, medicine and psychical research, so that experts in each subject were astonished when afterwards told that the man to whom they had been talking was not a specialist in their own line of research. His encyclopædic knowledge, practical ability, and readiness to take any amount of trouble whenever his help was asked were of great value to his friends, and to the University, especially in his capacity of a syndic of the University Press, an office to which he was repeatedly elected for many years.

Lamb spent most of his spare time in collecting and studying insects. He specialized on the flies, working for some years with Dr. David Sharp, and such was his ability in this direction that he became a recognized authority on certain groups of the Acalypteræ, especially the Ephydridæ and the Drosophilidæ, describing many new species. He was a real naturalist, and was a mine of information on the habits and life-histories of the insects he studied. His most important research was the study of the Diptera of the Seychelles, of the 428 species of which 28 genera and 311 species were previously unknown. He also did most valuable work in the Insect Department of the University Museum of Zoology, where he was in effect honorary curator of the Diptera for many years. For his zoological work, the University conferred upon him the degree of Sc.D. in 1923, and on his retirement from the Engineering Laboratory in 1931 he was created emeritus reader in electrical engineering.

Lamb never lost his early interest in music; although of late years even his most intimate friends could seldom prevail on him to play to them. As a freemason, he was a well-known figure in both town and University, and attained high rank. As a lecturer, he sometimes failed to appreciate that his mind worked faster than that of any but the most able of his audience, but he never grudged the time to explain privately any difficulties. To Cambridge zoological research he was for twenty years the valued referee whenever mathematical conceptions were involved. No student, colleague or friend ever asked his help in vain.

C. R. C.

Mrs. Beatrice Bateson

THE recent death of Mrs. Beatrice Bateson, widow of William Bateson, F.R.S., has meant more than the loss to her own immediate friends. A link with the past has been broken, and many of his former pupil and colleagues will recall the integral part she played in those memorable days at Grantchester or Merton—a Saturday afternoon, a Sunday lunch—where the sense of intellectual freedom and curiosity, the spaciousness and the humour, were of her making as well as of his. She was always there to help, whether it was Japanese prints, embroideries, a display of home art, the chicken-pens or the greenhouses that formed the absorbing interest of the moment.

In recent years, when her own talents and her own energy had to stand alone, Mrs. Bateson's labours were mainly threefold; she made her garden in Sussex a delight, and with her needle she produced embroideries of great beauty of design and execution. But more important than trowel or needle was her piano; even within a few months of her death, under able and kindly guidance, she was mastering the intricacies of Bach with the enthusiasm and intensity of youth.

To Mrs. Bateson is due the biographical sketch of her husband, published in 1928: "William Bateson, F.R.S., Naturalist, His Essays and Addresses, together with a Short Account of his Life", which must form an important work of reference to some future biographer.

Of their sons, the eldest was killed in the War of 1914–18, and the second died in London shortly after. Gregory Bateson, the anthropologist, now working in America, is the youngest and only surviving son. Mrs. Bateson was the third daughter of Dr. Durham.

Her single-minded devotion to the things of the mind will remain embodied in the memory of her music-room in Sussex—the adapted bakehouse of the small Mill House. Two grand pianos of the smallest size could just fit in; on the window-sill stood a pot or two of her orchids, while one window looked straight into her beloved miniature greenhouse. On the walls and in the book-cases were many treasures, ranging from Blake to the Chinese, each eagerly acquired in the early days, each loved for its own sake and for its associations. In that room was no place for ignorance or for idleness.

WE regret to announce the following deaths:

Mr. E. O. F. Brown, president of the Institution of Mining Engineers, on May 22, aged fifty-nine.

The Right Hon. Lord Cadman, G.C.M.G., F.R.S., Chairman of the Anglo-Iranian Oil Company, Ltd., and the Irak Petroleum Company, Ltd., emeritus professor of mining and petroleum technology in the University of Birmingham on May 31, aged sixty-three.

Prof. Oskar Loew formerly professor of plant physiology in the University of Berlin, aged ninety-seven.

Dr. R. Campbell Thompson, F.B.A., Shillito reader in Assyriology in the University of Oxford, on May 23, aged sixty-four.

NEWS AND VIEWS

The Right Hon. Winston Churchill, F.R.S.

UNDER a statute of the Royal Society which provides for the election of persons who either have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society, the Right Hon. Winston S. Churchill was elected a fellow of the Royal Society on May 29.

The admission of the Prime Minister to the Royal Society, although to some extent in accordance with precedent, is in Mr. Churchill's case thoroughly justified by his interest in, and appreciation of, scientific developments. Time and again, in speeches in the House of Commons and in broadcast addresses, he has stressed the importance of making the fullest possible use of science to combat the "perverted science", as he has rightly termed it, of Nazism, which has been nurtured for the purpose of destroying life and property and enslaving the souls of men. He was quick to appreciate the use which was being made by our enemies of scientific developments, and equally swift to realize that scientific men in Great Britain have the knowledge and skill to counter their attacks. Moreover, he has not hesitated to pay public tribute to their work, as witness his statement in the House of Commons when he proclaimed the defeat of the magnetic mine, which for a few weeks had taken a heavy toll of our ships. This awareness of the significance of scientific developments culminated in the appointment last October of the Scientific Advisory Committee, to which reference has frequently been made in these columns, whereby the leading research institutions of the country are enabled to maintain direct contact with the Cabinet itself. Mr. Churchill's election to the fellowship of the Royal Society is a timely recognition by the world of science of his services to the British Empire, to the cause of democracy and not least to the cause of science itself.

The Royal Society: New Foreign Members

PROF. J. B. CONANT and Dr. K. Landsteiner have recently been elected foreign members of the Royal Society.

Prof. J. B. Conant, For. Mem. R.S.

PROF. JAMES BRYANT CONANT held the position of professor of chemistry and head of the Chemical Faculty at Harvard up to 1933, when he was elected to the high office of president of the University. In relinquishing his post in the Department of Chemistry, although the University as a whole gained, American science lost to a large extent one of its most distinguished investigators. Nevertheless, Prof. Conant never abandoned chemical research, and has published original work continuously up to the present time. His researches cover an impressive range of subjects, and are especially noteworthy by the novelty of the physical chemical approach and the skill with which this has been employed in the field of organic chemistry. Although it is impossible adequately to indicate the scope of his work in a short summary, some idea of his versatility can be gained by mention of some of the major themes. These include: (*a*) A comprehensive study of the addition of phosphorus halides to organic compounds in the course of which entirely novel reactions were brought to light; (*b*) Numerous publications dealing with the study of oxidation-reduction potentials of organic compounds, including hæmin and related substances; (*c*) Investigations of free radicals and the kinetics of their formation; (*d*) The application of physical methods to structural problems of organic chemistry; (*e*) The study of reaction mechanism as applied both to substitution displacements and keto-enol tautomerism; (*f*) Researches on the constitution of chlorophyll and the related porphyrin groups; (*g*) Biological-chemical applications of induced radioactive indicators.

In all his numerous publications one is struck with the freshness of outlook with which Prof. Conant approaches the subject. His intuitive faculty and deep insight into the fundamentals are matched by notable experimental skill. The work with which his name is most clearly associated is that relating to the constitution of chlorophyll. In this field his contributions have been outstanding; he cleared up many of the more obscure points in the structural relationship of the chlorophyll group, and contributed matter of the highest originality. His work is entirely independent of that of Hans Fischer and, although not so extensive in scope, certainly of equal merit. To specify a few major examples of his chlorophyll work one might cite the fact that he was the first to provide conclusive evidence of the close connexion between the green derivatives of chlorophyll and porphyrins. Similarly, his work on the 'allomerization' of chlorophyll is peculiarly fascinating; he was the first to recognize it as an oxidation, a discovery which led directly to a complete understanding of this complex phenomenon. He initiated with Prof. Kistiakowski the important series of exact measurements of the heats of organic reactions which the latter has been carrying on up to the present time. Since his appointment to his present office he has devoted his energies and talents to raising the standard of teaching and research in universities, and to promoting liberty of thought and expression. Prof. Conant has also had a considerable influence on the development of the organic chemical industry in the United States, and in this connexion it is worthy of note that his scientific initiative as a consultant was an important factor in the success of Carothers's work on new polymers. Finally, during the past three years he has devoted as much of his time as his many duties would permit to educating public opinion in the United States to appreciate the full value of maintaining a true democratic outlook, and his present appointment by President Roosevelt testifies to the success of his efforts and the confidence the latter has in him.

Dr. K. Landsteiner, For. Mem. R.S.

WORKERS in the field of medical research in Great Britain will wish to join in congratulating Dr. Karl Landsteiner, of the Rockefeller Institute in New York, on his recent election, and will regard the honour as being a well-merited tribute to the high level of the scientific work he has pursued with unremitting vigour during the past forty years. Three outstanding achievements will forever be associated with his name: the discovery of individual differences in human blood which account for the four well-defined groups; the demonstration, together with E. Popper, that the causal agent of acute poliomyelitis is transmissible to monkeys; and the series of notable contributions he has made towards elucidating the nature of the specificity of immunological reactions.

Dr. Landsteiner was an assistant in the Institute of Pathology of the University of Vienna when, in 1901, he first published his work on iso-agglutination and the blood groups. Even at this early date he was aware of the probable significance of his results for medico-legal purposes, and in the practice of blood transfusion; and the value of his pioneer researches on the subject was attested when, in 1930, he was awarded the Nobel Prize in Medicine. The two first papers on the experimental transmission of poliomyelitis to monkeys appeared in 1908 and 1909, and they pointed the way to the subsequent intensive study by himself and by many other workers of the mode of transmission of the causal virus and of its neutralization by a specific immune-serum. In later years Landsteiner and his collaborators have been occupied chiefly with the chemical aspects of immunity. Their investigations and, in particular, the ingenious experiments with artificially conjugated antigens and the corresponding immune-sera have shed much light on the nature of the serological specificity of proteins and cell antigens.

Plankton as a Source of Food

THE interesting article which we publish in another column (p. 695) is of special importance inasmuch as it is from the pen of a distinguished leader in the investigation of marine plankton and its distribution. As the first occupant of the chair of zoology in University College, Hull, Prof. Hardy has wisely borne in mind its proximity to the great fishing-port of Grimsby, and has directed the policy of his department along lines which, as he believes, will lead towards increased prosperity of the fishing industry. The ingenious apparatus which he has devised for towing behind a moving vessel and registering a continuous record—quantitative and qualitative—of the plankton present along the route traversed is well known to all interested in plankton research, and it may well be that the not distant future will see this apparatus installed as part of the regular equipment of vessels engaged in the fishery of those important food-fish—such as herring, pilchard or mackerel—which, subsisting on particular types of plankton, tend naturally to concentrate where their favourite food happens for the time being to be most abundant.

Prof. Hardy, on the whole, supports Sir John Graham Kerr's plea for the appointment of an expert committee to examine into the practicability or otherwise of drawing upon the plankton directly for the reinforcement of the food supply of Great Britain. He emphasizes the nutritive value of plankton. He quotes chemical analyses, which we find perhaps less impressive since an encounter many years ago with a destructive beetle larva which was able to subsist upon a diet of dry cork, and out of it—in apparently complete defiance of all dietetic principles—to build up living protoplasm indistinguishable chemically from that of a human being. But Prof. Hardy tells us too how not long before the outbreak of war, German researchers reported upon two different types of plankton as being respectively equivalent in nutritive value to 'the best meat' and to rye flour. Finally, he quotes the case of the whalebone whales, and, unmindful of the reminder conveyed in a charming leading article in *The Times* regarding their ungainly portliness, the more seriously directs attention to the extraordinarily rapid growth of the young whale as incontrovertible evidence of the nourishing qualities of its food. The practical suggestions made by Prof. Hardy in regard to the large-scale collection of plankton, are, in view of his special knowledge, worthy of attention, and no less so his hint that the preliminary stages in the working out of the plankton-food problems might well be undertaken during the present summer.

Coastal Plankton of New South Wales

PROF. W. J. DAKIN has been working for nine years at the study of plankton off Sydney Harbour. The difficulties were many, but a great deal has been accomplished which acquires a deeper significance when one realizes that it is the preliminary to further fisheries researches in the future. A small yacht only was available, but with this, fortnightly samples of plankton with accompanying hydrographic data (the last only for the first three years) were taken almost continuously. The results, which include much original work not published elsewhere, are now available ("The Plankton of the Australian Coastal Waters off New South Wales. Part 1." Publications of the University of Sydney. Department of Zoology. Monograph No. 1. By William J. Dakin and Alan N. Colefax. 1940). There is, however, much more in it, for it is a general guide to Australian plankton indispensable to all who study the subject in these waters, the introductions give a good survey of each group, and almost every organism is described and, in most cases, figured. Lists of relevant literature are given at the end of each section and certain specialists have helped in identifications. Mr. Takasi Tokioka's contribution on the Chætognatha with its beautiful figures is noteworthy. Mr. Alan Colefax is responsible for the large and detailed section on the Copepoda and also for the chemical analyses.

Prof. Dakin is the author of the main part of the work. Among the Crustacea his notes on life-histories are valuable, especially among the Decapods. The larval stages of the Australian Decapods are little known, and this is obviously an extensive field for research. Larval Thalassinids form a large part of the plankton, especially inshore. "In one quarter-hour haul at Broken Bay in April 1935, there were hundreds of thousands of larvæ in different stages." Gurney, in the "Discovery" Reports (1938), has shown that there are many more Thalassinid larvæ than known adults (especially belonging to the Axiid-Callianassid group). Here again in Sydney Harbour the adults are not known, except in a very few instances. The larvæ occur at certain stated times. It will be interesting to hear of more researches on these forms—a difficult subject, as these Thalassinids live in very inaccessible places, and there must be an enormous number of undescribed species. The present work deals mainly with invertebrates, but there is a small section on fish eggs. Further work on these and on other groups here not fully dealt with are subjects for the future.

War-Time Medicinal Formulæ

THE direction of the policy which is being adopted in the compilation of war-time formulæ for medicinal preparations is indicated by the nature of the recommendations recently made by the British Pharmaceutical Codex Revision Committee. It may well be that there is little need to replace all those drugs now unobtainable by alternative substances. On the other hand, it is very desirable that authoritative guidance should be given to prescribers as to substitutes for at least some of the scarce or unobtainable drugs, and also as to the best combinations in which to present them. This duty falls upon several bodies recognized as being properly constituted for the purpose, and one such is the Codex Revision Committee.

The recommendations made by this body are not restricted to the replacement of scarce substances by those which are more freely available. They cover a wider field. Thus it is proposed to authorize the use of tap water in place of distilled water except in injections and in preparations for which the pharmacist may consider distilled water more suitable. To the patient who invariably uses tap water to dilute his medicines, where dilution is directed, there appears to be nothing remarkable in this recommendation and there would seem to be little reason why it should not continue to be applied in peace-time. With regard to alcohol the Committee, following the advice of the Medical Research Council, that, in order to observe economy in the use of alcohol, many tinctures should be replaced by concentrated preparations, agrees that concentrated liquid extracts should be employed instead of tinctures and has decided to draw up a list of liquid extracts which might be used for this purpose. Other recommendations have their origin in the scarcity of tragacanth, squill, liquid paraffin, olive oil and almond oil.

Food Growing and Utilization

IT is fully recognized that the amateur gardeners and allotment holders of Great Britain are making a vital contribution to the war effort. Maximum crops need to be raised and any wastage through faulty storage or cooking must be avoided. The "Penguin Book of Food Growing, Storing and Cooking", by Mr. F. W. P. Carter, provides much practical information in a simple manner on these subjects (Penguin Special, S.90. Harmondsworth: Penguin Books, Ltd. 6*d*.). Crops are dealt with alphabetically which makes reference simple. The method of cultivation, recommended varieties, quantity of seed required, likely pests and their control, storage and where possible also cooking methods are described for all the more commonly grown vegetables. Good general information is also given regarding the preparation of the soil. The booklet concludes with simple suggestions for garden work each month and a detailed cropping plan for a period of three years on a typical allotment.

The correct utilization of food is dealt with by Mr. Frank Wokes in another Penguin Special, "Food: the Deciding Factor" (S. 87. 6*d*. Much information on food values and diet is compressed into a small space. The energy and body-building values of different types of food are explained, and diets suggested which make for properly balanced meals, rationing being taken into account. A considerable part of the booklet is devoted to the question of vitamins, the quantities required and the foods which supply them. Interesting tables are given in the appendix showing the body-building and energy values, mineral and vitamin contents of a large number of generally consumed articles of food, including cereals, dairy produce, fish, fruit, meat and nuts.

Institute of Physics: Industrial Radiology Group

FOR some considerable time, physicists engaged in the various branches of industrial radiology have expressed a wish for some means whereby they could come together for the mutual discussion of their particular problems. Accordingly, the London and Home Counties' Branch of the Institute of Physics arranged a Conference on Industrial Radiography in January 1941 (see NATURE, February 8, p. 183). As a result of this Conference it was decided to ask the Board of the Institute of Physics to approve the formation of a Radiography Group. The Board's approval having been obtained, the inaugural meeting of the Group was held on May 20, at the Social Centre of Messrs. Kodak, Ltd., Harrow, about seventy people attending—some coming from as far afield as Leven, Motherwell, Sheffield and Derby. The title "Industrial Radiology Group" being approved by those present, Dr. L. Mullins, of the Research Laboratory of Messrs. Kodak, Ltd., was appointed honorary secretary, and the following committee was elected: Drs. W. Betteridge, D. W. Davison, and H. Lowery, Messrs. A. N. Gilchrist, W. L. Harper, H. P. Rooksby, H. S. Tasker, D. E. Thomas, and E. J. Tunnicliffe.

So constituted, the present committee is representative of those concerned with the industrial applications of radiography and X-ray crystallography and of those engaged in the manufacture of industrial X-ray apparatus and X-ray films. In addition, the British Institute of Radiology and the

Society of Radiographers are to be asked to send one representative each to serve on the committee. This committee was given power to elect its own chairman and to formulate a constitution for the Group. In addition to providing a medium for the exchange of views and experiences on the practice of radiography and X-ray crystallography in industry, it is to be hoped that the Group may ultimately issue a report summarizing many of the essential practical points of importance to users of X-ray plant, as one noticed at the above-mentioned Conference that many quite elementary matters of technique were not generally known in the various industries employing X-rays. Membership of the Industrial Radiology Group is open to all who are interested, whether or not they are at present members of the Institute of Physics.

Association of Scientific Workers

THE annual council meeting of the Association of Scientific Workers was held in Birmingham on May 24 and 25 ; eighty delegates were present representing scientific workers and engineers in industrial and Government posts as well as university staff and students. As this was the first council meeting to be held since the registration of the Association as a trade union, the reports presented, and the ensuing discussion, were chiefly concerned with the planning of an industrial policy for the Association. Discussion centred mainly around a report by the Industrial Sub-Committee which analysed the present conditions of scientific and engineering staff. This report showed that even under peace-time conditions, there is a considerable difference between salaries paid to people having the same qualifications but employed by different firms. In the engineering industry, for example, the general salary level is notably less than in certain chemical firms. Increments were often obtained by negotiation between the employer and the individual, but war-time restrictions on change of employment have removed the individual's chief bargaining instrument. A survey among members of the Association shows that there is a marked tendency in industry for no increments to be given, while in Government establishments war-time posts carry a fixed salary.

It was pointed out in the discussion that cancellation of increments is particularly unfair to the younger scientific workers whose salaries are frozen at the low starting figure. Attention was also directed to the injustices caused by failure to grant payment for overtime to many scientific workers and engineers. It was said to be a common experience, particularly in large firms, for hours of work and holidays to be altered suddenly without consultation with the unorganized sections of the staff. The conclusion drawn by the Industrial Sub-committee of the Association and endorsed by the council meeting is that collective action through the Association is the only effective method by which engineers and scientific workers can safeguard their conditions, and bring them into relationship with those of organized sections of industry. The council unanimously adopted a resolution in favour of close co-operation between the Association and other trade unions.

Mummification in America

REFERENCE has already been made (NATURE, April 5, p. 413) to the first part of a description by Dr. Aleš Hrdlička, curator of physical anthropology in the U.S. National Museum, of investigations undertaken in mummy caves and rock shelters in the Aleutian Islands off the coast of Alaska (*Scientific Monthly*, Jan.–Feb. 1941). It would appear that the aboriginal inhabitants were at some unknown period replaced by the Aleuts, among whom, comparatively lately, Russian penetration took place. The Aleuts practised mummifying, though whether they began to do so after their arrival in the islands or whether they brought the custom with them from their unknown place of origin remains a mystery. The mummies of both sexes were stored in the caves lying upon driftwood, and differences of physical anthropology among them suggest that a few members of the pre-Aleut people had been allowed to survive, perhaps in a condition of slavery. The finding of one or two objects of Russian origin with some of the mummies seems to indicate that the practice continued until a fairly recent date. A certain amount of cremation also appears to have been customary, and interesting and well-developed industries showing some degree of artistry were collected. The difficulties under which the expedition worked were very considerable, but nevertheless much valuable information has been added to our knowledge of these interesting peoples.

The practice of mummifying the dead, like that of trephination, is always intriguing. Why should these elaborate processes have been undertaken at all ? Connected as they often were with magic or religious notions, their discovery sometimes throws a side-light on the ideas of bygone peoples; whereas a study of the ordinary industries of such folk only determines their material culture—only tells us how they lived, not how they thought. Actually, mummifying has never been a common method of dealing with the dead either in modern or in ancient times. Egypt, of course, furnishes the classic example, but in the New World there were peoples both in South and North America who practised the rite. The orthodox diffusionist naturally claims that the custom in, say, Peru derived from Egypt; but frankly it is difficult to believe that the two or three prehistoric American peoples really had any connexion either with the Old World or with each other. It would seem far more likely to have been the result of a spontaneous development consequent upon a somewhat similar outlook on death.

Floating Electric Power Plants

MR. A. C. HARDY, in an article entitled "The Electric Ship" in the *Electrician* of May 2, outlines some recent trends and developments. A project for a 50,000 kw. self-contained, floating power plant is being studied by the General Electric Co., Schenectady. The plant is to be housed in a hull of similar dimensions to that of a Great Lakes freighter capable of passing through the Welland Canal, the dimensions being limited to 290 ft. by 43 ft., with a draught of 10 ft. and a low-bridge clearance of 15 ft. It is recalled that this idea is not new, for two 10,000 kw. turbo-generators were installed in the hull of the *Jacona*, a vessel built during the War of 1914–18, and since 1930 used as a floating power plant in New England. This vessel was taken in hand at the works of the Newport News Shipbuilding and Dry Dock Co. The main engine boilers and auxiliary formerly used for propulsion were removed. The funnel, foremast and four forward winches, propeller, shaft-tunnel and shafting were removed. New watertight bulkheads were installed fore and aft, and special thickening was fitted underneath the power plant. Two steam turbo-generators were installed, taking steam from four marine boilers, delivering 280,000 lb. of steam per hour at 425 lb. pressure at 250° F. superheat. The steam consumption of the turbines is about 9·4 lb. per kwh. at full load, the turbines being directly connected. With the exception of a few auxiliaries, the whole of the plant is divisible into two separate units, two boilers being arranged to serve each turbine. The method of making electrical connexion to the shore is a problem involving considerable study.

James Nasmyth as Tool Maker

WHEN James Nasmyth (1808–1890) was twenty-six years of age he set up in business as an engineer in Manchester, and two years later, at Patricroft on the Bridgewater Canal, he established the famous Bridgewater Foundry, so named after the Great Duke. By 1856, Nasmyth was able to retire and devote himself to astronomy. The foundry, however, was carried on successfully by others until July 1940, when it became a Government ordnance factory. One consequence of this was the presentation to the Institution of Mechanical Engineers, by Sir Holberry Mensforth, of Nasmyth's well-known "Sketch Book" and a portfolio of early drawings. Most of the drawings are of steam hammers, but others relate to machine tools. Some of these are of exceptional interest, and in *The Engineer* of May 23, Dr. H. W. Dickinson gives a review of Nasmyth's pioneering work in this department of engineering. As an appendix to the article a transcription is given of a letter written in 1864, in which Nasmyth refers to his discovery of the 'willow leaf' pattern on the sun's surface, a discovery which "has made a great stir among astronomers".

Activated Charcoals from Peat Residue

IN the tenth part of a series of "Studies in Peat", J. Reilly and J. R. O'Donoghue (*Sci. Proc. Roy. Dublin Soc.*, 22 (N.S.), 367; 1941) report experiments on the preparation of activated charcoals from peat. Before preparing the charcoal, waxy constituents were removed. Of various methods used, activation with superheated steam, and, to a lesser extent, by treatment with syrupy phosphoric acid before carbonization were found to be best for producing charcoals of performance approaching commercial standards. So far as is known, the peat residue is the first substance of Irish origin to be examined as a source of active charcoal.

Earthquakes in Turkey

THAT the earth's crust has not yet settled down after the disastrous Turkish earthquakes of December 1939 is evidenced by recent earthquake activity in that country. Minor shocks are frequently experienced, and stronger ones occur from time to time. Two such happened during the last fortnight. A strong earthquake on May 24 broke the sea wall at Mugla, opposite the island of Rhodes. Some other damage and twenty casualties have been reported at Mugla, and less intense shocks were experienced at Smyrna. During the night of May 30–31, a strong tremor was felt in Anatolia, causing serious damage to a large number of houses. No casualties have been reported as a result of this shock.

Announcements

PROF. L. J. MORDELL, F.R.S., Fielden professor of pure mathematics in the University of Manchester, has been awarded the De Morgan Medal of the London Mathematical Society.

DR. J. A. VENN, president of Queens' College, Cambridge, and Gilbey lecturer in agricultural economics and history, has been elected vice-chancellor of the University for the academical year beginning on October 1, in succession to Mr. E. A. Benians, master of St. John's College, who has held the office for the customary two years.

The Adams Prize for 1939–40, valued at about £268, has been awarded to Dr. Harold Davenport, assistant lecturer in mathematics in the University of Manchester. Dr. Davenport, who graduated as a wrangler, was formerly a fellow of Trinity College.

THE herbarium near Hudiksvall, in Sweden, containing thirty thousand specimens of roses, compiled and classified by the late Reinhold Matsson, the Swedish botanist, has been destroyed by a fire.

A NEW division of chemotherapy has been formed in the National Institute of Health of the United States Public Health Service to be under the direction of Dr. William H. Sebrell, jun. The new unit will be concerned with research on sulphanilamide products and with new synthetic drugs with antimalarial properties, in order to make the United States independent of the Dutch East Indies supply of quinine. The division will have quarters at the National Institute of Health in Bethesda, Maryland. The building will also be the headquarters of the divisions of chemistry and zoology.

ERRATUM. The title of the letter by Dr. H. L. A. Tarr in NATURE of April 5, p. 417, should read "The Bacteriostatic Action of Nitrites"; thus the work relates to "nitrites" and not to "nitrates" as printed.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

Further Correlation of Physical and Biological Properties in an Acridine Series

THE partition coefficients between olive oil and water of the five monoaminoacridines[1] have been investigated, and the results, set out in the accompanying table, include acridine and proflavine (2 : 8-diaminoacridine) for comparison.

The method followed was to dissolve the amine hydrochloride in a large excess of phosphate buffer solution (pH 7·0) and to shake this for two hours at 25° C. with sufficient acid-free olive oil[2] to extract approximately half the amine. The emulsion was centrifuged and the aqueous layer compared in a colorimeter with the unextracted solution. The latter was then diluted to the concentration found for the extracted solution, and the two were again compared in order to compensate for any deviation from Beer's Law. Finally where, as in the cases of 3- and 4-aminoacridines, there is a profound change of colour on acidification, both solutions were brought to pH 2·5 and again compared. Concordant readings were given by all methods. The concentrations of each amine at equilibrium were arranged to vary in different experiments, the aqueous layer containing 0·5–3·0 mgm. per 100 ml. in regular steps. In spite of this sixfold variation, no change in the coefficient was noted, indicating that association does not take place.

On account of the sparing solubility in water of acridine and 1-aminoacridine, it was necessary to devise a modified technique by reversing Farmer's procedure[3] for calculating the dissociation constant of an amine from its partition coefficient. Accordingly 1-aminoacridine was extracted by oil from its solutions in $N/100$ sulphuric acid and the aqueous layer (pH 2·1) compared with unextracted solution brought to the same pH value. The amount of amine in the oil was found by subtraction and was divided by the amount of free base existing in the aqueous layer at equilibrium as found from the equation :

$$\log\frac{[B]}{[BH]} = p\text{H} - 14 - \log K \quad . \quad . \quad . \quad \text{(i)}$$

which is derived from $\frac{[B][H]}{[BH]} = \frac{10^{-14}}{K}$,

$[B]$ and $[BH]$ representing concentrations of free base and its salt respectively.

Since salt-formation has been taken into consideration, partition coefficients calculated as above are comparable[3] with those found at pH 7, at which value 1-aminoacridine and acridine are almost entirely hydrolysed. Acridine, being almost colourless, was estimated by precipitation with excess picrolonic acid, filtration through fritted glass, and titration of the uncombined picrolonic acid with methylene blue[4].

It will be seen from the table that there is a correlation of physical and biological properties in this series in so far as the members most active against bacteria are the most basic and the most hydrophilic, whereas the least basic and most hydrophobic members have only feeble antiseptic properties.

	Partition coefficient oil/water	Dissociation constant, water, 25° C. × 10^{-10}	Bacteriostatic index[1]. (Sum total of inhibitory dilutions)	Average lethal dose (mouse)	Bactericidal value[5]
				gm./kgm.	
5-Aminoacridine	1	300,000	43	0·08	96
Proflavine	0·5	120,000	41	0·14	92
2-Aminoacridine	5	12,000	41	0·17	82
4-Aminoacridine	55	30	17	0·33	61
3-Aminoacridine	90	12	17	0·33	56
Acridine	250	2	12	0·30	Not tried
1-Aminoacridine	1200	1	8	0·91	49

The bacteriostatic index is quoted from a previous communication[1]. The average lethal dose ($L.D.$ 50) was found by subcutaneous injection of mice using 6–12 mice for each dose and interpolating for a 50 per cent kill after plotting the logarithm of each dose against the percentage killed. It will be noted that the mammalian toxicity rises with the bacteriostatic index, but as the latter figure represents powers of 2, it can be shown that the mammalian toxicity does not tend to rise on so steep a gradient as the toxicity to bacteria. The bactericidal values quoted in the table represent the percentage reduction of hæmolytic streptococci effected by a 1 : 10,000 concentration of the derivative in 10 per cent serum broth after two hours at 37° C.

The causes underlying the correlations are not yet clear. The hydrophilic properties of the strong bases are not due to the fact that they exist mainly as salts at pH 7. For example, 5-aminoacridine, which at pH 7 contains only 0·3 per cent of free base (from equation (1)), has its partition coefficient of 1 raised only to 3 at pH 10 where it contains 80 per cent of free base. Moreover the biological properties may be found to depend not so much on the basicity as on the various types[1] of amino groups which the basicities indicate.

The biological results quoted in this paper will appear elsewhere in greater detail[5]. Meanwhile 5-aminoacridine is undergoing clinical trial as a non-staining antiseptic with the general properties of proflavine.

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[1] Albert, A., Rubbo, S. D., and Goldacre, R., NATURE, **147**, 332 (1941).

[2] Anon., *Pharmaceut. J.*, **132**, 635 (1934).

[3] Farmer, F. J., *J. Chem. Soc.*, **79**, 863 (1901) ; Farmer, R. C., and Warth, F. J., *ibid.*, **85**, 1713 (1904).

[4] Bolliger, A., *Analyst*, **64**, 416 (1939).

[5] Rubbo, S. D., Albert, A., and Maxwell, M. (in preparation).

'Crossed Fibrillar' Structure of Plant Cell Walls

THE so-called 'crossed fibrillar' structure observed in the walls of some plant cells[1,2,3] and inferred in a variety of others[4] still awaits explanation, and although the evidence for its presence in the latter cases can scarcely be considered satisfactory[5], this type of structure is sufficiently widespread to present a problem of the first magnitude in cell-wall physics. Several attempts have been made in these columns and elsewhere to define the underlying mechanism, and it is the purpose of this note to point out a new possibility which arises from the recent work of Astbury and Bell[6]. The importance of the organization of the protoplasmic surface in considerations of wall structure is now slowly being realized, and recent evidence[1] suggests that it is in this surface that we are to seek the mechanism involved in the regular alternation of chain orientation implied by the crossed fibrillar structure. Now in the recent emendation put forward by Astbury and Bell of what may be called the 'classical' model of protein structure, the fibrous proteins keratin and myosin are considered always to be *effectively* in the β-configuration whatever the state of folding [see Figs. 1, 2 and 3, p. 698 of this issue for diagrams of the α- and β-configurations; the supercontracted form would resemble the diagram given by Astbury and Bell for the globular proteins]. The contraction of the α- or of the β- form to the supercontracted condition now corresponds in this model to an effective rotation of the constituent protein chains to the transverse direction.

This type of folding surely gives expression to an underlying principle common to all proteins, including those in the cytoplasm-wall interface, and if we adopt the assumption now being formulated vaguely by some workers that the cellulose chains in a new layer may be oriented in a direction governed by the underlying protein chains, we have a ready solution of the present problem. The direction of cellulose chains may be alternated simply by alternate extension and contraction of the protein chain molecules in the protoplasmic surface. Confirmation of this idea will naturally not be easy. No single cell type has yet been worked out in sufficient detail, but evidence derived from a number of sources is already suggestive.

There are reported in the literature a few cases in which the cellulose chains of the primary wall in an elongated cell lie almost transversely and in later walls layers almost longitudinally[3]. Together with this we may put also the various observations that the physical properties of the cytoplasm in meristematic cells are often different from those in cells becoming adult. We have, for example, numerous statements that high metabolic activity is associated with low cytoplasmic viscosity[7], with one specific observation that in the hyphæ of Rhizopus (the wall of which is of chitin with a structure closely resembling that of cellulose) the viscosity in the growth zone is much less than elsewhere[8]. Changes in viscosity may, of course, be due to any one of a number of causes, but we do know that in some cases a change in fluidity is associated with changes in the configuration of a protein, for example, with contraction of muscle[9], and they are precisely what we should expect if, on passing from the meristematic to the adult state, the proteins in the surface are extending. Similarly we have some grounds for thinking that the *p*H of cytoplasm in a meristem may not be far removed from the isoelectric point of its constituent proteins[10], whereas in adult cells it lies near the point of neutrality. It is well known that proteins are *p*H sensitive and that in some cases *p*H change, though not the causative factor, is associated with muscular contraction[8].

The contraction and extension of the protein chains is naturally to be considered as occurring, or at least being initiated, locally; it has no effect on the external appearance of the cell, the shape of which continues to be controlled by the surrounding cellulose envelope. It is difficult to be precise at this stage, particularly with cells like Valonia, Chætomorpha and Cladophora, where the crossed fibrillar structure manifests itself most markedly. It may be significant that changes in cytoplasmic viscosity often accompany nuclear division.

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May 1.

[1] Astbury and Preston, *Proc. Roy. Soc.*, B, 129, 54 (1940).

Preston and Astbury, *Proc. Roy. Soc.*, B, 122, 76 (1937); Nicolai and Frey-Wyssling, *Protoplasma*, 30, 403 (1938); Preston, *Ann. Bot.*, (N.S.) 3, 507 (1939).

[3] van Iterson, *Protoplasma*, 27, 190 (1937); Anderson and Kerr, *Ind. Eng. Chem.*, 30, 48 (1938).

[4] Freudenberg and Durr, "Kleins Handbuch der Pflanzenanalyse", 3, 142 (1932); Bailey and Kerr, *J. Arnold Arbor.*, 16, 273 (1935).

[5] Preston, *Proc. Leeds Phil. Soc.*, 3, 546 (1939); *Biol. Rev.*, 14, 281 (1939).

[6] Astbury and Bell, NATURE [p. 696 of this issue].

[7] Frey-Wyssling, "Submik. Morphol. des Protoplasmas und seiner Derivate" (Berlin, 1938); Guillermond, "Traité de Cytologie végétale" (1933); Seifriz, "Protoplasm" (New York and London, 1936).

[8] Guillermond, *loc. cit*[5].

[9] Frey-Wyssling, *loc. cit.*[5].

[10] Pearsall and Priestley, *New Phyt.*, 22–3, 185 (1923).

Chemical Substitutes for Dietary Protein

THE stimulating article by Dr. Benesch on the utilization of non-protein nitrogenous compounds as protein substitutes which was recently published in NATURE[1] is a timely contribution to an important subject. At the outset, Dr. Benesch explains that his object in writing the article is to show that "the problem has reached a practical stage". This opinion is, however, by no means shared by all those who have studied the voluminous literature on the subject published (mainly from the Continent) during the past twenty years. In fact the attitude of Krebs, who reviewed the subject exhaustively in 1937, is in many respects diametrically opposed to that of Dr. Benesch. Moreover, it is all too frequently found that the same set of results is accorded entirely opposite interpretations according to the particular outlook of the workers concerned.

In view of this conflict of opinion, and having in mind the probable war-time shortage of feeding-stuffs, a group of research workers at the Hannah Institute began, about two years ago, a series of experiments designed to reinvestigate the value of urea and ammonium salts as protein substitutes for milk production. An endeavour was made to plan the details of the experiments with sufficient care to ensure that the final results would not readily lend themselves to alternative interpretations, due to the inclusion of inadequate controls or to the recording of incomplete experimental data.

The programme of work finally adopted was twofold. In the first section of the work lactating cows were fed on a diet which was just adequate according to present accepted feeding-standards and which contained a protein of first-class biological value for milk production. This was compared with the same diet in which one third of the protein of the production ration was replaced by urea. Milk yields, body weights, nitrogen balances, creatine-creatinine excretion, milk composition and the partition of nitrogen in the blood were all studied.

In the second section of the work, use was made of a steer with a large rumen fistula to determine, both by *in vivo* and *in vitro* methods, whether protein synthesis could actually be observed in the rumen contents, and, if so, what were the major factors affecting the magnitude and efficiency of such synthesis. In this work the research group was able to secure the valuable co-operation of Mr. Frank Baker of Guildford, who for some years has devoted much time to the study of the microflora and fauna of the rumen and cæcum of Herbivora.

It is hoped that the detailed results of much of the work will be available for publication within the next few months. The two most important findings may meantime be stated tentatively and briefly as follows: (1) Urea, which was first rapidly converted into ammonium salts in the rumen, proved to be of unquestionable value as a partial substitute for protein in the feeding of dairy cattle, *provided that it was fed in proper amounts and in a suitable mixture.* It was readily eaten by the animals and was without ill effects either on their general health or on the yield and quality of their milk. (2) In the course of *in vitro* incubations of rumen contents in which the general conditions of the medium and the microbiological picture (so far as it could be judged) were similar to those in the intact rumen, the conversion of non-protein nitrogen to protein was clearly demonstrable. This conversion, though small, was sufficient to account for the effective utilization of much more urea than would normally be included in the diet of the lactating cow.

The views expressed by Dr. Benesch on this subject, at least in so far as milk production is concerned, appear, therefore, to be fully supported by the present work. Moreover, it is pertinent to note that in the course of the investigation some of the excellent suggestions which he makes for future work have already been put into practice.

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[1] NATURE, **147**, 531 (1941).

"Vegetables as Food"

IN a recent article in NATURE[1], it is stated that there is less carotene (provitamin A) in carrots than in spinach, watercress or broccoli. It would be dangerous to allow this statement to pass unchallenged. In reality, as was pointed out in a recent review in these columns[2], the carrot stands pre-eminent as a source of provitamin A. It is the only common foodstuff in Great Britain continuously available throughout the year, a single daily helping of which will supply the full requirement for vitamin A. It is unfortunate, therefore, that doubt should have been cast on this unique virtue of the carrot.

We have made many estimations in this Laboratory and rarely find a carrot having less than 18,000 I.U. per 100 gm. The usual value is more than 20,000, and values up to 38,000 have been obtained. Several varieties have been tested, the sizes varying from 10 to 1,250 gm. While leafy vegetables may be much superior to the carrot in respect of iron and water-soluble vitamins, few of them approach it in carotene content. For example, we find watercress has 2,500–5,000 I.U. per 100 gm., Brussels sprouts 200–600; common cress 1,500.

A possible explanation of the low value given by Dr. Pyke for carrots is that it has been taken from the published comprehensive Tables of Vitamin Values. Considerable discrimination is needed in the use of these compilations. Some of the entries for a given food are of little value compared with others, either because they are based on less accurate work, or because they represent single values rather than ranges of variations. Sometimes differences between species and varieties or the effects of other variables (for example, season, degree of ripeness, etc.) are overlooked. In the determinations on carrots we find that low results are obtained unless precautions are taken to ensure complete extraction and to avoid destruction of the carotene. The range of values for carrot given in Fixsen and Roscoe's tables[3], namely, 3,300–22,000 I.U. per 100 g., places the maximum where in our experience the mean should be. Unfortunately this range, or a mean obtained from it, is copied into other tables and books. The only common green vegetable quoted in these tables which even approaches these values is spinach (4,400–11,000).

We feel also that Dr. Pyke exaggerates when he makes an allusion, divorced from its context, to cooked cabbage as having only 17 per cent of the vitamin C of the fresh cabbage. Workers who have had most experience on the effects of cooking and processing would agree that under average household conditions a more usual loss would be of the order of about 40–50 per cent. With improved methods of cooking (such as boiling in a minimum of water for a minimum time, or by modified casserole cooking), the loss may be so low as 20 per cent.

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[1] Pyke, M., NATURE, **147**, 513 (1941).
[2] NATURE, **147**, 132 (1941).
[3] Fixsen, M. A. B., and Roscoe, M. H., *Nutrit. Abstr. Rev.*, **9**, 795 (1940).

IN NATURE of April 26 a comprehensive report is given of the meeting of the Nutrition Panel of the Society of Chemical Industry on "Vegetables as Food".

It is unfortunate that some of the facts on vitamin C given in our individual papers have been, in our opinion, misrepresented in this report, so that a false impression is given of the antiscorbutic value of cooked and canned vegetables. Some form of heat treatment is essential for the palatability of most vegetables. It is true that during such treatment a loss of vitamin C occurs, but to refer to "the devastating effect of cooking on the vitamin C in vegetables" and "the loss of the bulk of vitamin C" in the blanching process of canning, is to strain this fact out of its true perspective.

As we emphasized in our communications at the meeting, cooked and canned vegetables have, during this winter, been the main source of vitamin C for the majority of people in Great Britain. In addition we showed that normal portions of such vegetables, if properly chosen and handled by the housewife, can adequately supply the full daily requirement of the vitamin.

We would emphasize these points in view of the economic importance of heated vegetables under existing conditions.

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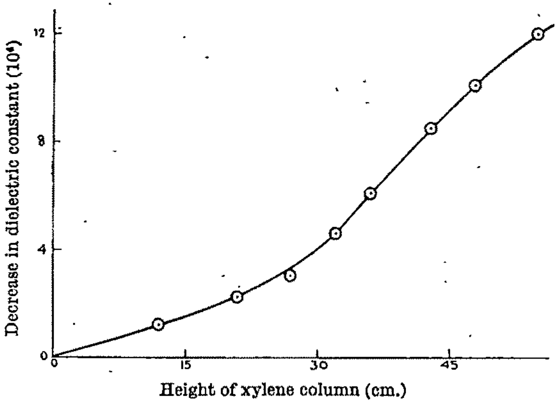
Effect of Flow on the Dielectric Constant of Liquids

We have observed that certain liquids, for example, xylene (a mixture of *ortho-*, *para-* and *meta-*), ethyl ether, ethyl alcohol and benzene show very small yet distinct decreases in the values of their dielectric constants when they are flowing through condenser plates of small separations. With a given separation the amount of change is found to increase with the rate of flow of the liquid. A typical graph showing the variations in the dielectric constant of a freshly distilled sample of xylene (a mixture of *ortho-*, *para-* and *meta-*) with flow under the pressure of different heights of the liquid is given in the accompanying graph. The temperature of the xylene remained practically constant at 24·0° C. throughout the experiment.

All the measurements for the dielectric constant were made by the usual heterodyne beat method using a wave-length of 300 metres. The experimental condenser consists of two horizontal circular brass plates; the lower one forms the main body of the apparatus, and the upper is separated from it by small, thin pieces of mica (thickness of the order of 0·01–0·02 cm.). The lower plate is provided with an opening at the centre which is connected by means of a U-tube to a long vertical glass tube of internal diameter 2·4 cm. The U-tube is fitted with a stopper. The upper plate is of diameter 8·6 cm. and of thickness 0·6 cm. and is fitted with a vertical rod at the centre. A load of about 10 kgm. is kept above the disk to prevent any mechanical displacement of the disk due to the hydrostatic pressure or flow of the liquids.

The condenser, the connecting tube and the vertical glass tube are filled with the liquid, and the flow of the latter commences as soon as the stopper is opened. The liquid rises through the central opening of the lower plate and after passing through the narrow space between the plates of the condenser comes out and is collected in a receiver. The level of the liquid in the vertical glass tube is kept constant by feeding the liquid at an adjusted rate from above. The changes in the capacity of the experimental condenser during flow are measured with the help of a specially designed condenser used by one of us[1] in the measurement of the dielectric constant of an electron atmosphere. With this condenser changes so small as 0·004 μμF. can be measured.

Precautions were taken to see that changes observed in the capacity during the flow of the liquid were not due to any spurious effect such as mechanical displacement of disk or similar stray capacity changes. The entire experimental arrangement is enclosed in a case lined with tin which is connected to the earth; all adjustments are made from outside.



Changes in the dielectric constant during flow are observed in polar as well as in non-polar liquids. But a more viscous liquid like amyl alcohol is found to show the effect to a much smaller degree. Observations with liquid heights greater than that shown in the graph could not be taken due to certain practical difficulties. Further investigations are, however, in progress and a detailed report will be published elsewhere.

We are grateful to Principal K. Prosad for the keen interest he has taken in this work.

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Feb. 24.

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[1] Prasad, S. P., and Varma, M. N., *Z. Phys.*, **99**, 552 (1936).

Kinetic Friction Coefficient

The ordinary static friction apparatus with one mass m hanging over a pulley and connected to another mass M resting on the friction board may be used to determine the kinetic coefficient. Let m be more than sufficient just to move M, and let h be the vertical height over which m is allowed to accelerate M; then, if x is the extra distance along the board traversed by M before it is brought to rest by friction, the average coefficient is given by:

$$\mu_k = \frac{m}{M + \frac{(M+m)x}{h}}.$$

By varying m in order to get a range of speed, the following fairly consistent values were got:

M (gm.)	m (gm.)	Coefficient of kinetic friction
74·4	42·7	0·33
74·4	52·7	0·33
74·4	62·7	0·32
74·4	72·7	0·33
74·4	82·7	0·36
74·4	92·7	0·32
74·4	102·7	0·32
74·4	112·7	0·33
74·4	122·7	0·33

It may be that the method is in use, but a search in our selection of books on practical physics has not disclosed it.

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RESEARCH ITEMS

Ptinid Beetles of Economic Importance

IN the *Bulletin of Entomological Research* (31, 331–381; 1941), H. E. Hinton, of the British Museum (Natural History), contributes a critical revision of 21 species of the family Ptinidæ that have been recorded as pests. The object of this work is to illustrate and describe these species in sufficient detail in order to facilitate their ready and accurate identification. In general, these beetles are known to infest an enormously wide range of stored products, and occur in houses, drug stores, warehouses and granaries. Some species have been found in association with such apparently unpromising substances as cayenne pepper, opium, argol and indiarubber. Others have been found in grain, nests of bees, in fish meal, cacao, in insect collections, birds' nests, etc. Three British species of Ptinus are of no economic importance, but have been included so as to make the paper applicable to all the British Ptinidæ. Six of the species of this family have not so far been found in Britain. It is interesting to note that several of the species have been known since the end of the eighteenth century, while *Ptinus fur* was described by Linnæus as *Cerambyx fur* in the "Systema Naturæ" (1758).

Chiasma Interference

H. B. NEWCOMBE (*Genetics*, 26, 128–137; 1941) has shown that coincidence values obtained from the direct observation of the position of chiasmata in *Trillium erectum* correspond with those of genetical analysis of cross-overs. Interference in an arm of a chromosome may still be present in a distance of 2 microns; above this distance the coincidence value does not differ from unity. Across the attachment constriction the value is significantly greater than unity. An increase in chiasma frequency is accompanied by decreased coincidence across the centromere and increased coincidence within an arm.

Inert Chromosomes

C. D. Darlington and M. B. Upcott (*J. Gen.*, 41, 275–297; 1941), have examined the behaviour of the *B* or supernumerary chromosomes of maize. These chromosomes are heterochromatic and have an excessive nucleic acid charge. Their chiasma frequency is less than proportionate to their length on the *A* chromosome standard. Since these *B* chromosomes may be reduplicated, it can be shown that the crossing-over frequency is increased with odd numbers of chromosomes; this is due to the potential increase in change of pairing partners. *B* chromosomes are irregular in behaviour during mitosis and meiosis and may be lost or give rise to chromosomes with deletions. On the other hand, lines of maize show a constant number of *B* chromosomes. Therefore, there would appear to be a selection pressure favouring *B* chromosomes. Thus the inert chromosomes would appear to be active in some physiological sense.

Sexuality in Wild Populations

THE occurrence of peculiar sex forms in species of plants has been a puzzle to many workers. In contrast to pure diœcism in higher animals, sex intergrades occur irregularly among plant species which are predominantly hermaphrodite. D. Lewis (*New Phyt.*, 40, 56; 1941) has shown that male-sterility of hermaphrodites due to cytoplasmic causes has more chance of survival than that due to genic male-sterility. With genic male sterility the frequency of 'females' in a population is 50 per cent and in no case can an equilibrium between 'females' and 'hermaphrodites' be reached unless the females are initially twice as fertile as hermaphrodites. On the other hand, cytoplasmic male-sterility can produce 100 per cent 'females'. If the 'females' have only a slight advantage over the hermaphrodites they will spread in the population. This advantage may be one of compulsory outbreeding, thus giving rise to hybrid offspring. Cytoplasmic sterility, therefore, is sensitive to several selective agencies in the wild population.

North Pacific Earthquake of November 10, 1938

AN important investigation is at present being made by K. E. Bullen and J. F. de Lisle on Rayleigh waves from the North Pacific earthquake of November 10, 1938. On account of the importance of this earthquake in the problem of Pacific crustal structure due to the unusually large and clear surface waves, J. F. de Lisle has estimated the degree of accuracy of the epicentre and origin-time used (Wellington, New Zealand: Dominion Observatory Bull. No. *S*-58; 1941). To do this a careful investigation was made of the *P* residuals, taking into account the ellipticity corrections. The author has shown by this work that the epicentre as assumed by the Jesuit Seismological Association, namely, 55·6° N., 157·7° W. is subject to an uncertainty probably not exceeding 0·3° in an east–west and 0·1° in a north–south direction, while the origin time of 20h. 18m. 48s. G.M.T. probably needs a correction of — 3 seconds.

A Closed Dyke-Sill Intrusion in the Transvaal

AN intrusion of altered quartz-dolerite of unique form, occurring in Marievale Mine and adjoining mines on the Far East Rand, is described by J. Ellis (*Trans. Geol. Soc. Africa*, 43, 127–142; 1941). The shape of the intrusion is that of a stepped dome of alternating dyke and sill phases. The intrusion, known in the mines as the 'Old Lady', never reached the surface, the top being of sill-like form below the Kimberley Shale. Against the inside of the dyke phases the strata are vertically displaced, the downthrow being equal to the thickness of the sill phase and generally of the order 150–200 ft. The dyke phases form closed rings at the levels where they occur, and there has been little or no horizontal separation of the strata. The mechanics of the intrusion are discussed in considerable detail. It is shown that the formations above the sill phases were not uplifted, but that subsidence of the rocks enclosed within the intrusion took place. The cause of subsidence, which cannot have been very deep-seated, is sought in the Basement Complex. It is suggested that the latter was weakened or melted by the rise of basic magma, and it is thought possible that the quartz-dolerite may be the result of contamination by granite of a parental basaltic magma. Evidence is presented that the age of the intrusion is just before or just after that of the Ventersdorp lavas which, petrochemically, are of similar type. Owing to the unusual shape, the reef displacement, and the toughness of the rock, the 'Old Lady' is everywhere a considerable source of embarrassment in mining operations.

Age of the Monchiquite Dykes of Colonsay

Two monchiquite dykes occurring in Colonsay belong to a suite of monchiquite and camptonite dykes, commonly following a north-west trend, of which members have been found in Coll, Iona, Mull and various parts of the mainland of Argyll. Although on grounds of petrographic analogy these are all thought to be of the same age, their geological relations nowhere provide direct evidence of what that age may be. The ages of the Colonsay examples have now been determined by the helium method by W. D. Urry, and for comparative purposes the ages of two Carboniferous basic rocks from Shropshire have also been measured. Petrological, chemical and other details of the rocks are provided by A. Holmes, who supplied the specimens, and the results are published in a joint paper (*Geol. Mag.*, 78, 45; 1941). Arising in part out of this investigation, it was found in 1937 that many of the helium ratios on which the 'helium' time-scale had been based were too high, because of a previously unsuspected error in radium determinations due to reliance having been placed on a radium standard which was seriously at fault. The new results, together with a few others, are given in the following table, which forms the nucleus of a revised 'helium' scale.

Geological age	*Rock type and locality*	*Age in millions of years, of the helium scale*
Pliocene	Basalt, Oregon (1)	8
Miocene	Basalts, Washington (3)	10
Oligocene	Basalts, Silesia (3)	20
Cretaceous–Jurassic	Granodiorites, California (5)	60
Triassic	Dolerites and basalts, New Jersey—Nova Scotia (8)	93–105
	Monchiquite, Colonsay (4)	125
	Biotite-monchiquite, Colonsay (4)	130
Upper Carboniferous	Dolerite, Clee Hills, Shropshire (1)	135
Lower Carboniferous	Basalt, Little Wenlock, Shropshire (1)	140
Devonian	'Newbury Volcanic Rock', Massachusetts (1)	180

The Colonsay results fall between those for the Triassic and the Carboniferous. It is therefore concluded that the Colonsay monchiquites are of late Carboniferous or Permian age, with considerable probability in favour of the latter. It should be noticed that although the 'helium' time-scale is internally consistent, the 'ages' therein are much lower than those given by the 'lead' method. The reason for this discrepancy is not yet known, and several investigators are collaborating in the attempt to elucidate it.

Variability of Rainfall in New Zealand

WHEN considering the suitability of a climate for most agricultural purposes it is necessary to know not only the average rainfall but also its variability. It is doubtless this fact which has led to the publication of *Meteorological Office Note* No. 24 of the Air Department, New Zealand, by C. J. Seelye, entitled "Variability of Annual Rainfall in New Zealand". Since the annual rainfall only is dealt with, the variability can be shown in a single map which brings out clearly the main features of its geographical distribution, variability being expressed by the average percentage variation from the mean for a selected period, in this case 1901–35. In New Zealand, low variability results when the fall comes largely from persistent westerly winds, while the rainfall derived mainly from easterly winds and from tropical cyclones shows high variability. For these reasons, areas with more than 18 per cent variability are found only in the north, and those with less than 8 per cent only in the extreme south, while the east on the whole is more variable than the west. The extremes are 8·7 at Queenstown and 21·2 at Petane, to the north of Napier. New Zealand is slightly less fortunate than the British Isles, where variability ranges from about 6 to 17 per cent only, with an average of roughly 11 per cent, but is far more fortunate than many countries bordering the tropics, for example, Arabia and Egypt, where variability exceeds 50 per cent. Nevertheless, in individual years single stations in New Zealand sometimes show departures from the average that must be very disturbing from the point of view of agriculture, the district including Nelson and Marlborough providing extremes of only 44 per cent in 1915 and as much as 232 per cent in 1936; in Southland, on the other hand, the corresponding extremes are only 63 (in 1907) and 153 per cent (in 1913).

Harmonic Analysis of Barometric Pressure

THE harmonic analysis of barometric pressure has been greatly extended geographically in recent years, and the latest addition comes from the Meteorological Office of New Zealand. In *Meteorological Office Note* No. 23 of the Air Department, New Zealand, C. J. Seelye discusses the variations at Wellington, New Zealand, for the period July 1914 to December 1938, during which time a Short and Mason barograph was in operation, at first at a height of 16 ft. above mean sea-level, but after September 1930 at a height of 425 ft. The indications of the barograph were corrected by means of mercurial barometer readings at 9 a.m. N.Z.M.T., supplemented after September 1930 by additional readings at 11.30 a.m. and 3 p.m. N.Z.M.T. Monthly values of the amplitude and phase angle for the 24-hr., 12-hr., 8-hr. and 6-hr. terms are discussed in detail. Of these, the second is, of course, the largest, the amplitude varying from 0·49 millibars in November (early summer) to 0·40 mb. in June. It is on an average for the whole year roughly three times as large as the amplitude of the 24-hr. term. The existence of one annual minimum value of the amplitude of the 12-hr. term had been noted at eight other stations in the southern hemisphere by Kochanski, who observed that the normal rule is for maxima to occur at the equinoxes and minima at the solstices. The 8-hr. term has very regular characteristics, although much smaller than the two already described; it reaches a maximum in January and July, and almost disappears in March and October. An item of practical importance in weather forecasting, which is included in this study of pressure variation, is a table showing the mean barometric 'tendency' (that is, change in tenths of a millibar in 3 hr.) for different hours of the day, a quantity which when subtracted from the observed tendency leaves the portion which may be attributed to the movement or development of anticyclones or depressions.

Distribution of Electricity in Thunderclouds

OBSERVATIONS made on thunderstorms at Kew Observatory during 1937–39 are reported in detail by Sir George Simpson and G. D. Robinson (*Proc. Roy. Soc.*, A, **177**, 281; 1941). In every thundercloud there is a positive charge of electricity near the top of the cloud, where the temperature is below – 10° C., and a negative charge below the upper positive charge. The generation and separation of these charges occurs in the ice region, and the most probable cause is the collision of ice crystals in the turbulent air associated with the strong ascending currents in a thunderstorm. The collisions charge the ice negatively and the air positively, and it is the settling of the ice crystals relatively to the air which separates the positive and negative charges. Below the main negative charge in the lower half of the cloud there are in most, if not in all, thunderstorm, regions containing positive charges. With few exceptions the temperature where these positive charges occur is above the freezing-point. These low positive charges are associated with heavy rain and they are probably generated by the breaking of raindrops in ascending currents of air.

Ferric Thiocyanate

THE blood-red colour formed from ferric salts and thiocyanates in solution, usually attributed to ferric thiocyanate $Fe(CNS)_3$ (which is soluble in ether) has been regarded by Schlesinger and Van Valkenburgh (*J. Amer. Chem. Soc.*, **53**, 1212; 1931) as due to a complex anion $Fe(CNS)_4'''$, and this view has found its way into the literature. H. E. Bent and C. L French (*J. Amer. Chem. Soc.*, **63**, 568; 1941) have made a new investigation of the matter by a method in which the dependence of the molecular extinction coefficient of the solution on the concentration of ferric and thiocyanate ions at constant *p*H and ionic strength is measured, and they find no evidence for the existence of an ion $Fe(CNS)_6'''$. The supposed migration of the coloured ion towards the anode could not be confirmed; there was only a slight movement towards the cathode. The conclusion is reached that the coloured substance is a cation, $FeCNS^{\cdot\cdot}$, but more work is obviously necessary before the old view that it is undissociated ferric thiocyanate is definitely rejected.

Electrical Properties of Solids

THE properties over a wide temperature range have been determined by R. M. Fuoss for a number of polar polymers, such as polyvinyl chloride, subjected to alternating current at 60–10,000 cycles (*J. Amer. Chem. Soc.*, **63**, 369, 378, 385; 1941), the work extending also to mixtures. Characteristic maxima in absorption and dispersion in dielectric constant were found which are interpreted as determined by the size and strength of the polar group, by the length and flexibility of the bond of the polar group to the polymer chain, and by the nature and amount of a second component present as a plasticizer. The fundamental mechanism of alternating field response, it is concluded, is dipole rotation in a medium of high viscosity, the primary effect of temperature being to change this internal viscosity. A transition temperature is described as relating to a process of internal melting. For mixtures, the loss factor for a given frequency and temperature passes through a maximum at a concentration which is characteristic of a given plasticizer. The electrical properties are markedly non-linear in composition in the low concentration range. A method of calculating the distribution of relaxation times from the loss factor — frequency curve is given, and for systems containing polyvinyl chloride an approximate equation is given for these curves. The C–Cl moment in polyvinyl chloride is calculated as 2·0. The theory is in agreement with previous empirical conclusions concerning chain interaction in polymeric systems.

Molecular Anisotropy of Urea and Related Compounds

A CONSIDERABLE amount of data on the magnetic and optical properties of urea and related substances has been correlated in a paper by K. Lonsdale (*Proc. Roy. Soc.*, A, **177**, 272; 1941). From comparisons of the magnetic anisotropy of urea with that of the carbonate and nitrate groups it appears that the hydrogen bonds contribute little to the anisotropy. The anisotropy of the refractivities is greater in urea than in the carbonate group. Urea nitrate, urea oxalate, cyanuric acid dihydrate and anhydrous cyanuric acid all crystallize in larger structures, as shown by cleavage, X-ray, magnetic and optical data. Although the molecules in each layer are joined together by hydrogen bonds, the links between successive layers may not be hydrogen bonds since the layer to layer distance of 3·05 ± 0·10 A. is characteristic even of cyanuric triazide, which contains no hydrogen bonds.

Comet Cunningham, 1940 *c*.

IT is reported from the McDonald Observatory, Texas (*Harvard Announcement Card*, **556**; Jan. 8, 1941) that spectrograms of Comet Cunningham show near 3360 and 3090 A. two prominent groups of lines not hitherto observed in cometary spectra. The first group consists of seven lines of the (0, 0) and (1, 1) bands of the $^3\Pi \rightarrow {}^3\Sigma$ system of NH. The second, also comprising seven sharp lines, arises from the (0, 0) transition of the $^2\Sigma \rightarrow {}^2\Pi$ system of OH. Other ultra-violet lines on the same spectrograms are attributed, though with less certainty, to CH and CN. The identification of NH and OH adds two more molecules to the five previously recognized in comets: CN, C_2, CH, CO^+ and N_2^+. As with these latter, the observed lines of the newly discovered molecules arise from resonance transitions, and the current theory of resonance excitation is adequate to account for their presence. In the visual region, the *D* lines of sodium appeared faintly in emission at the end of December and strengthened rapidly in early January. This, too, is to be expected since the comet made its closest approach to the sun in mid-January. A series of excellent direct photographs of the comet appearing in the *Telescope* of Jan.–Feb., 1941, traces its development from discovery in September 1940 to the end of the year.

DEFICIENCY OF WHITE FLOUR IN RIBOFLAVIN

(Tested with the Flour Beetle *Tribolium confusum*)

By Dr. G. Fraenkel and M. Blewett,

Department of Zoology and Applied Entomology, Imperial College, London

THE experiments described here were suggested by the decision of the Ministry of Food to "fortify" white flour by the addition of vitamin B_1 and salts, and by the criticism raised against this proposal (for example, Chick 1940[1], Willcox 1941[2]).

It is to-day general knowledge that highly milled white flour, as compared with wholemeal flour, is deficient in vitamins of the B group and salts and also contains less fat-soluble substances and protein. To use an insect as test animal for vitamins is no novelty, although this method has hitherto been little used. The flour beetle, *Tribolium confusum*, particularly has several times proved to be a very satisfactory test animal owing to its small size, its short life-cycle and its ability to grow normally on substances with a water content of only 10–15 per cent[3-8]. In testing for nutritional deficiencies in flour it is a particularly favourable experimental subject, since flour is its natural food and no other food is required.

If the environmental factors of humidity and temperature are kept constant and at a favourable level, for example, in the experiments described here at 25° C. and 70 per cent humidity (corresponding to a water content of about 14 per cent), the speed of growth is optimal on wholemeal flour and the mortality is almost nil. On interfering with the composition of the food any nutritional deficiency expresses itself in retardation of growth and sometimes also in increased mortality. As the growing period is finished with the formation of the pupa the duration of the larval stage from the hatching of the larva from the egg until pupation constitutes the most significant figure for comparing the efficiencies of different diets.

Long ago it was pointed out that growth of Tribolium is much retarded on white flour. This is shown in the graphs of Fig. 1. On wholemeal flour pupation takes place after 25–28 days, and on a sample of highly milled patent flour (Burtonsbest, extraction about 40 per cent) 32–48 days. National straight run flour (extraction 73 per cent), the highest extraction permitted during the War for baking of white bread, on which pupation takes place after 29–32 days, shows a great improvement over patent flour, but is still markedly and significantly behind wholemeal flour in nutritional qualities. Addition of wheat germ to patent flour in increasing quantities results in the developmental period being progressively shortened until, with 2–4 per cent germ present in patent flour, its efficiency is about the same as that of wholemeal flour. In the wheat grain the germ constitutes about 2 per cent. Admixture of yeast (dried brewer's) to patent flour produces an even slightly more favourable effect than admixture of wheat germ. It therefore appears that if the external conditions are kept sufficiently constant small amounts of wheat germ admixed into a sample of highly milled flour can be assessed with a fair degree of accuracy by feeding the flour to Tribolium.

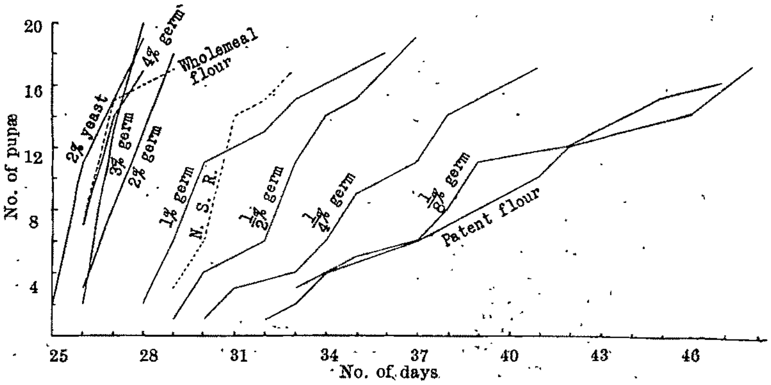

Fig. 1.

Larval growth of *Tribolium confusum* on wholemeal flour, National straight run flour (N.S.R.), patent flour and on patent flour supplemented by varying amounts of wheat germ or by yeast.

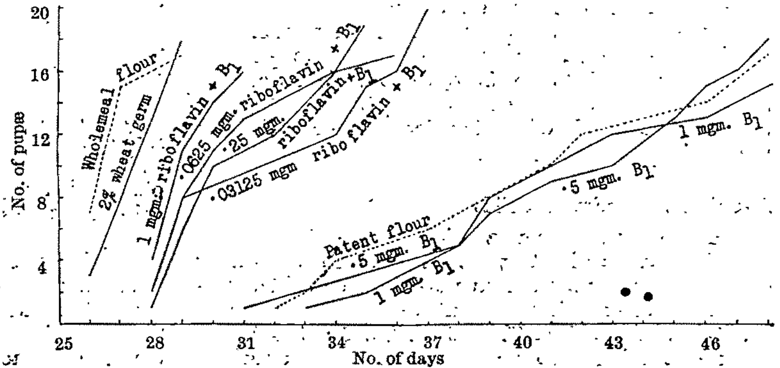

Fig. 2.

Larval growth of *Tribolium confusum* on patent flour supplemented by vitamin B_1 and riboflavin. Quantities per 2 gm. of food.

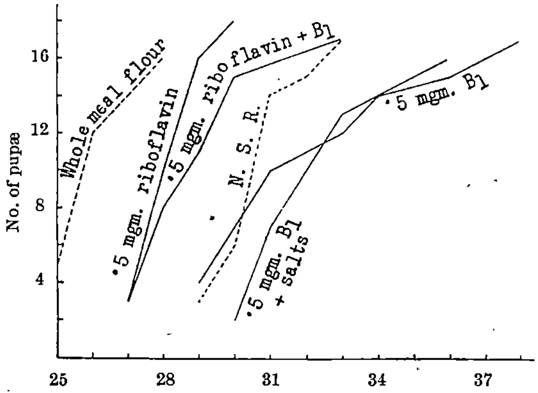

Fig. 3.

LARVAL GROWTH OF *Tribolium confusum* ON NATIONAL STRAIGHT RUN FLOUR (N.S.R.) AND ON N.S.R. SUPPLEMENTED BY VITAMIN B_1, RIBOFLAVIN AND SALTS. QUANTITIES PER 2 GM. OF FOOD.

Addition of pure vitamin B_1 (aneurin) to patent flour does not in the least alter its nutritional qualities ; addition of riboflavin, however, to patent flour containing vitamin B_1 causes a very startling improvement (Fig. 2). We have found that very small quantities of riboflavin produce a marked effect (0·031 mgm. per 2 gm. of food). (Fröbrich (1939)[7] has shown Tribolium to grow well on food containing only 0·008 mgm. of riboflavin in 1·5 gm. of food. Larger quantities were found to be toxic, but we cannot confirm this.) The apparent differences in the efficiency of diets containing different quantities of riboflavin are possibly not significant and may be due to insufficient mixing. Riboflavin was mixed with patent flour in the dry state, and the series was obtained by dilution with more patent flour. It appears, therefore, that most of the deficiency of patent flour is remedied by addition of riboflavin. In this dilution series with riboflavin the diets also contained vitamin B_1 (0·5 mgm. per 2 gm. of food). Later experiments proved, however, that the same favourable effect is produced without adding B_1.

Similar experiments with National straight run flour (N.S.R.) led to the same kind of results (Fig. 3). Although the nutritional qualities of N.S.R. for Tribolium are not much inferior to those of wholemeal flour, addition of riboflavin to N.S.R. produced a marked improvement. Adding B_1 to N.S.R. alone or to N.S.R. plus riboflavin caused the diets to be slightly less efficient, which, however, might not be significant.

An attempt was also made to find out whether any deficiency of salts in patent flour and N.S.R. could be demonstrated. Addition of MacCollum's salt mixture in the proportion of 1 per cent to patent flour and to N.S.R., however, showed no significant effect (Fig. 3).

The results obtained with Tribolium fully agree with those recently reported by H. Chick[1] on the white rat. In both cases the nutritive value of N.S.R., even when supplemented with vitamin B_1 and salts, is markedly inferior to that of wholemeal flour. Chick's suggestion that this may be partly due to deficiency in riboflavin has been proved to be correct. Most of this deficiency is corrected by adding riboflavin. Moreover, the efficiency of patent flour and N.S.R. both supplemented with riboflavin is almost identical, and the efficiency of supplemented patent flour is apparently greater than that of unsupplemented N.S.R. (Figs. 2 and 3). This proves that the nutritional difference, demonstrable with Tribolium, between the two kinds of white flour of 40 and 73 per cent extraction is almost entirely due to lack of riboflavin in patent flour.

No practical conclusion can be drawn from the fact that Tribolium does not need more B_1 than is present in patent flour. Since the deficiency of white flour in B_1 is well known and the need of Tribolium for B_1 has been demonstrated, the amount of B_1 in patent flour seems to be well above the threshold of the requirements of Tribolium. On the other hand, if one considers the very low requirements of Tribolium for riboflavin and the startling improvement in the nutritional qualities of white flour after adding riboflavin, the deficiency of patent flour and even straight run flour in riboflavin must be regarded as being serious. Supplementing white flour with vitamin B_1 would, therefore, leave the deficiency in riboflavin unremedied.

We wish to thank Dr. J. D. Mountfield, of the Research Association of British Flour Millers, for supplying samples of National straight run flour, patent flour and wheat germ.

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[2] Willcox, W., *Food*, **10**, 147 (1941).
[3] Chapman, R. N., *J. Gen. Physiol.*, **6**, 565 (1924).
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[8] Offhaus, K., *Z. vergl. Physiol.*, **27**, 384–428 (1939).

FATIGUE FOLLOWING HIGHLY SKILLED WORK*

BY PROF. F. C. BARTLETT, F.R.S.

IF the character and causation of fatigue following highly skilled work are to be understood, the first need is for the discovery of more relevant and experimentally controlled facts. Unfortunately, almost all the investigators who have attempted to study fatigue of this type have adopted methods taken over with very slight change from those which have proved valuable in the study of simple muscular fatigue. They have chosen elementary operations usually considered to require some 'mental' effort—such as easy calculations, word or colour recognition and naming and the like—have repeated these operations over and over again for long periods, and have tried to express the resulting fatigue in terms of the diminution in quantity or quality of the work done.[1]

The skill fatigue of daily life is not set up under such conditions. Routine repetition of simple actions

* Substance of the Ferrier Lecture of the Royal Society, delivered on May 29.

is not characteristic of any highly skilled work, and least of all of work having a strong 'mental' component. The operations involved here are marked by complex, co-ordinated and accurately *timed* activities. The stimuli in response to which these activities are set up are neither simple nor do they usually fall into an order of fixed succession. They have the character of a field, or a pattern, which has become very highly organized, and may retain its identity in spite of a great diversity of internal arrangement.

It is possible to develop fully controlled experimental situations in which these realistic considerations have full play. When this is done, the picture of fatigue following highly skilled work which emerges has certain strongly marked characters.

In such fatigue the 'standards' accepted and followed by the central nervous system unwittingly deteriorate. The operator tends to think that he is doing better work, because errors treated as significant all the time get wider and wider limits. Until a stage of great fatigue is reached, it is far more likely that the right actions will be performed at the wrong times than that the wrong actions will be performed. If accurate timing is insisted upon, gross mistakes of action may appear. The stimulus field splits up. Its pattern character alters. It becomes a collection of unconnected signals for action, with some of these predominant over all the others. Particularly stimuli which are in the margin of the pattern, not closely organized with the central field, are ignored, 'forgotten', and serious lapses of specific reactions occur. There is a marked change in the effect of certain 'distracting', or additional stimuli. Sensations of bodily origin, in particular, become more pressing and insistent, and affect the performance in ways peculiar to the tired operator.

Side by side with all these changes go constant subjective symptoms. Verbal reports about any circumstances connected with known failure of performance become increasingly inaccurate, and errors are regularly projected upon objective conditions, or attributed to the interference of other people. There is a tremendous growth of irritability.

The light thrown by this picture upon the relation of high-level central nervous functions to simpler neuro-muscular mechanisms was discussed.

ROLE OF RADIATION MUTATIONS IN MANKIND*

By Dr. H. J. Muller

ACCEPTING, on the basis of work with organisms in general, including mice, the conclusion that X-rays and other high-energy radiations produce gene mutations in any human germ cells that are exposed to them, with a frequency exactly proportional to the dose of radiation used, we may ask: What are the conditions governing the manifestation of these mutations? When attention is confined to the recessive gene-mutations, which appear as the most pronounced and constant, yet insidious, genetic effects, it may be approximately calculated how long the latent period would be between the time of exposure of an individual who afterwards reproduces and the appearance of some descendant manifesting a recessive mutation that had been produced in one of the former's germ cells.

For the manifestation of a recessive gene two germ cells having the same allelically acting recessive genes must come together, forming a homozygote—an event that would happen with almost negligible frequency in the first-generation offspring, even from two irradiated parents. There are, however, two ways in which a homozygote manifesting the mutated gene could eventually be formed. One is by a germ cell containing it meeting in fertilization another germ cell which chances to contain an identical or allelic recessive gene which, having originated by some independent mutation, was already present in the population in some parallel line of descent. The chance of this event depends upon the frequency of such recessive mutated genes in the general population, and this can be calculated if we know the so-called 'spontaneous' mutation frequency, the rate at which individuals manifesting such genes are being eliminated in competition with normals, and the amount of inbreeding in the population. Sufficient data exist for calculating that under the condition of random breeding—which would give the highest frequency of such genes—very few recessive genes the manifestation of which would be of seriously detrimental character would exist in frequencies exceeding 1 in 30 or, more probably, 100 germ cells, in the general population. Thus it would on the average require some 30 or, more likely, 100 or more generations of breeding—some 750–3,000 years of human history—before the mutated gene would manifest itself by this process.

The other way in which the gene could manifest itself would be by a germ cell containing it meeting another containing a relative, so to speak, of the same gene, that is, an identical gene derived from the same ancestral mutated gene of the original treated individual. This requires the breeding together of more or less related individuals—'inbreeding'—and the chance of its occurrence depends on the total amount of inbreeding occurring in the population. In determining the frequency of this effect a special method of calculation has been employed, utilizing a simple proportionate relation of 1 to 4 which I have calculated to hold between the frequency of two related genes thus meeting each other and the frequency of two individuals having the same name by reason of some near or distant relationship marrying each other. Reckoning from known statistics on the latter events, it can be shown that, even in rural English communities, the chance of a mutated gene manifesting itself by this process is only about 1 in 200. That is, it would on the average take about 200 generations, or at least 5,000 years, for the gene to attain manifestation in such manner. Both causes operating together would not suffice to give a period of less than 600 years, and more probably one of thousands of years.

Of course these periods are only averages for the time of first manifestation; actually, the first manifestations of the different mutated genes would be scattered rather evenly over the entire time from the generation after treatment until two or three times the length of the 'latent period' had elapsed It is to be noted, further, that this protracted 'latent period' does not mean that the mutated genes would tend, collectively, to become lost in the interim, since for each gene that died out by accident, in its 'covered' state, another would, on the average, increase in numbers, and so the final number of individuals first manifesting the mutations would fairly accurately represent the number of individuals produced in the first generation after treatment who had received the newly mutated genes. That is, the damage would be long postponed, but not prevented.

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* Substance of a paper read at the annual meeting during April 28–29 of the U.S. National Academy of Sciences.

In so far as the individuals manifesting the abnormalities might themselves reproduce they would give them a chance to reappear repeatedly, until competition with the normals finally eliminated them. The recognition of these abnormals as having been produced by the original treatment would, however, be impossible, not only because of the long latent period but because they would appear merely as one relatively small part of the vast number of mutations that had occurred in the distant past, from all causes combined, and that had accumulated in the germ plasm. It can be shown that even if the mutation frequency of the population as a whole were doubled, in a given generation, by treatment of all of them with an average dose of, say, 300 r. the frequency of mutations that *manifested themselves* in the population would not be increased, in any one generation, by as much as 1 per cent of their own total, since the manifestation of the new additions to the store of mutations would be scattered over so many generations. If, however, the exposure that doubled the mutation frequency were to be continued generation after generation, the manifestation frequency would gradually rise and finally (after some hundred generations) attain the double value representing the double mutation frequency.

In these circumstances, the advisability of allowing the gonads of a person of reproductive or pre-reproductive age to be exposed to radiation must be decided by balancing the chance of benefit to him against the chance of detriment to future generations. Far more quantitative research is needed on this matter, but it will often be clear that the decision should be in favour of the exposure. Whenever possible, however, a person's gonads should be protected by a lead shield.

As for the question of the mutational effects of natural radiation, while this has been calculated to be of no consequence in flies, the 700-fold greater length of the human generation gives a chance for the accumulation of a sufficient dosage—some 10–15 r. —to have an appreciable effect in view of its also being continued generation after generation. More exact studies are therefore called for concerning the circumstances attending exposure of populations to unusually high amounts of such radiation, as well as of radiation of artificial origin.

SKIN EFFECT IN COMPOSITE AND FERRO-MAGNETIC WIRES

THE British Electrical and Allied Industries Research Association has published a report by G. G. Sutton on the high-frequency properties of wire specimens*. Novel results have been found in connexion with the effect of a longitudinal magnetic field on wires made of magnetic material. Ferromagnetic wires are shown to have very high 'skin' factors, but the effective permeability determined from the experimental results is shown not to be constant but decreases to a small value as the frequency increases.

Earlier mathematical calculations have assumed a uniform known permeability, but it is known that with ferro-magnetic conductors the permeability varies with the magnetizing force, and hence it must vary over the cross-section of the conductor. It also varies with the current density and the temperature. In addition, hysteresis losses must be considered. Accordingly a mathematical solution is intrinsically very difficult, and it therefore seems necessary to have some direct means of measuring skin factor for magnetic and composite conductors.

The author describes two methods of doing this, both methods being based on thermal measurements. The first apparatus consists of two parallel brass tubes inside which were the specimen wire and a standard wire of eureka respectively. The heating effect of the current in the two wires was measured by observing the extensions by means of a travelling microscope. Both the eureka and iron wires were calibrated with direct current. A simple mathematical relation is then deduced to give the required skin factor. A more accurate method was afterwards developed, mercury being used at first as the indicating fluid, but it was abandoned as it was not sensitive enough. Finally, the liquid decided on was nitrobenzene as its physical properties were found most satisfactory.

The method of measurement developed for skin-factor measurements is shown to give consistent results with different types of specimen. The calculation of results in the case of ferro-magnetic materials is difficult, and in the case of composite materials it is very difficult. The author's method of measurement is direct and calculation is much simplified.

The method can be easily applied to the measurement of high-frequency currents. By further development it would be possible to eliminate many of the difficulties met with in this research. The effect of a longitudinal direct-current field on the high-frequency resistance of a mumetal specimen has been demonstrated ; this is in accord with results already published on the arc impedance of specimens of mumetal wire at telephonic frequencies. From the results obtained in the case of ferro-magnetic materials, the effective permeability has been calculated ; this tends to a small value as the frequency increases, as indicated by Arkadiew and others. Constructional diagrams are given for making the apparatus, and experimental diagrams are given showing the variation of skin factor with applied D.C. field in the case of a specimen of 26 S.W.G. mumetal wire.

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* Technical Report, Reference M/T 69: The High Frequency Properties of various Forms of Wire Specimens. By G. G. Sutton. Pp. 19+13 plates. (London: British Electrical and Allied Industries Research Association, 1941.) 6s.

FORTHCOMING EVENTS

Monday, June 9

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Squadron-Leader P. J. A. Riddell: "Air Photography in War".

Tuesday, June 10

CHEMICAL ENGINEERING GROUP (SOCIETY OF CHEMICAL INDUSTRY) in conjunction with the INSTITUTION OF CHEMICAL ENGINEERS (Joint Meeting at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. G. H. Miles: "The Human Factor in Chemical Engineering Processes".

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 2.30 p.m.—Miss Audrey I. Richards: "Some Causes of a Revival of Tribalism in South African Native Reserves".

Wednesday, June 11

INSTITUTION OF GAS ENGINEERS (at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1), at 10 a.m.—78th Annual General Meeting; at 10.30 a.m.—Mr. George Dixon: Presidential Address.

ROYAL SOCIETY OF ARTS (at the Institution of Electrical Engineers, Savoy Place, London, W.C.2), at 2.30 p.m.—Mr. F. C. R. Douglas: "Economic Aspects of Soil Fertility and Nutrition".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

BOROUGH EDUCATION OFFICER—The Secretary, Education Offices, Stoke Road, Gosport, Hants. (June 10).

FARM SURVEY SUPERVISORY OFFICER, an ASSISTANT ADVISORY CHEMIST, a FIELD ASSISTANT (AGRICULTURAL CHEMISTRY), and a PERMANENT TECHNICAL ASSISTANT (AGRICULTURAL ECONOMICS)—The Registrar, The University, Manchester 13 (June 11).

HEAD OF THE COMMERCIAL DEPARTMENT—The Principal, Technical College, Park Square, Luton (June 14).

PROFESSOR OF ZOOLOGY—The Secretary, The University, Edmund Street, Birmingham 1 (June 16).

ASSISTANT ENGINEER to the Middle Level Commissioners for Land Drainage Works—The Engineer, Middle Level Offices, March, Cambs. (June 16).

HEADMASTER—The Clerk to the Governors, Dulwich College, Dulwich, London, S.E.21 (June 21).

HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT of the Salford Royal Technical College—The Director of Education, Education Office, Chapel Street, Salford 3, Lancs. (June 21).

SECRETARY OF THE WESTERN DISTRICT OF THE WORKERS' EDUCATIONAL ASSOCIATION—The Acting District Secretary, 9 Ashley Park, St. Andrew's, Bristol 6 (June 28).

ASSISTANT TO THE ENGINEER-IN-CHIEF—The General Manager and Secretary, Mersey Docks and Harbour Board, Dock Office, Liverpool (June 30).

HEADMASTER of the High School for Boys—The Secretary, King Edward's School, Edgbaston Park Road, Birmingham 15 (July 5)

HEADMISTRESS of the High School for Girls—The Secretary, King Edward's School, Edgbaston Park Road, Birmingham 15 (July 5).

TRAVELLING INSPECTORS OF DRYING PLANT for the Dehydration Branch of the Emergency Services Division of the Ministry of Food—Ministry of Labour and National Service, Central Register (Z.184), Queen Anne's Chambers, Westminster, London, S.W.1.

ASSISTANT IN THE MECHANICAL ENGINEERING DEPARTMENT—The Principal, Technical College, Wolverton, Bucks.

ELECTRICAL ENGINEER for the Public Works Department of the Nigerian Government—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9422).

WARDEN—The Principal, Domestic Science College, Knighton Fields, Leicester.

WOMAN LECTURER TO ASSIST IN BIOLOGY AND GEOGRAPHY—The Principal, Edge Hill Training College, Bingley, Yorks.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 46, Section A, No. 13: Analysis of the (0,3) Band of the First Negative System of the O_2^+ Molecule. By T. E. Nevin and T. Murphy. Pp. 169–182. 1*s*. Vol. 46, Section B, No. 10: A List of the Irish Species of *Toxares* and *Ephedrus* (Hymenoptera: Aphidiidae) with Descriptions of these, which include Three Species New to Science. By A. W. Stelfox. Pp. 125–142. 1*s*. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [135

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 13: Hormonal Analysis of the Cyclic Variations in the Vascular Architecture of the Uterus of the Guinea-Pig. By Dr. P. Bacsich and Dr. G. M. Wyburn. Pp. 465–474+1 plate. (Edinburgh and London: Oliver and Boyd.) 1*s*. 6*d*. [165

Ollsgoil na h-Éireann (The National University of Ireland). Calendar for the Year 1940. Pp. x+346+696+480. (Dublin: National University of Ireland.) [195

British Rubber Producers' Research Association. Publication No. 8: Analytical Methods in Rubber Chemistry, Part 1. By E. H. Farmer, G. R. Tristram and J. L. Bolland. Pp. 16. (London: British Rubber Producers' Research Association.) [195

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. War Food Production, Advisory Bulletin No. 3: Herbage Seed Production. By Gwilym Evans. Pp. ii+30. (Aberystwyth: Welsh Plant Breeding Station.) 1*s*. [205

Report of the Marlborough College Natural History Society for the Year 1940. (No. 89.) Pp. 48+8 plates. (Marlborough: Marlborough College.) 3*s*.; to non-members, 5*s*. [205

Other Countries

Government of Iraq: Ministry of Defence: Meteorological Service. Annual Report of the Director, No. 4: Year ending 31st March 1940. Pp. 30. (Baghdad: Government Press.) [95

India Meteorological Department. Scientific Notes, Vol. 8, No. 90: Averages of Temperatures and Humidities in the Upper Air over Agra in the Polar Year 1932–33. By S. Basu, Ram Sahay and K. J. Kabraji. Pp. 77–84+6 plates. (Delhi: Manager of Publications.) 12 annas; 1*s*. [135

Cornell University: Agricultural Experiment Station. Bulletin 734: Use of Time in its Relation to Home Management. By Jean Warren. (Contribution from the Laboratories in Home Economics.) Pp. 98. Bulletin 736: Selective Factors in Migration from a New York Rural Community. By Amy A. Gessner. Pp. 56. Bulletin 737: Some Facts concerning Country Fruit and Vegetable Auctions in Eastern Seaboard States. By Edwin W. Cake. Pp. 52. Bulletin 738: Biology and Control of the Wheat Wireworm, *Agriotes Mancus* Say. By W. A. Rawlins. Pp. 30. Bulletin 740: Uninfected Elm Wood as a Source of the Bark Beetle (*Scolytus multistriatus* Marsham) carrying the Dutch Elm Disease Pathogen. By Donald L. Collins, K. G. Parker and Henry Dietrich. Pp. 14. Bulletin 741: The Business of Milk Retailing by Producer-Distributors in New York State. By Earl M. Hughes. Pp. 86. Bulletin 742: The Yellows Disease of Lettuce and Endive. By M. B. Linn. Pp. 33. Bulletin 744: Marketing New York Livestock. By W. M. Curtiss and E. H. Matzen. Pp. 36. Bulletin 745: Effects of Mineral-Nutrient Deficiencies and Excesses upon the Vegetative Growth and Flowering of Sweet Peas. By Kenneth Post. Pp. 28. Bulletin 746: Soil and Field-Crop Management for Southeastern New York. By A. F. Gustafson. Pp. 32. (Ithaca, N.Y.: Cornell University.) [145

The Rockefeller Foundation. A Review for 1940. By Raymond B. Fosdick. Pp. 64. (New York: Rockefeller Foundation.) [155

Records of the Geological Survey of India. Vol. 75, 1940, Professional Paper No. 9: The Cambrian Fauna of the Salt Range of India. By W. B. R. King. Pp. 16+5 plates. (Calcutta: Geological Survey of India.) 1.2 rupees; 1*s*. 9*d*. [155

The South African Journal of Science. Vol. 37: Being the Report of the South African Association for the Advancement of Science, 1940, Johannesburg. Pp. xxi+438. (Johannesburg: South African Association for the Advancement of Science.) 30*s*. net. [155

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Acting Director of Agriculture for 1939. By E. Roderigo. Pp. D34. (Colombo: Government Record Office.) 50 cents. [165

United States Department of Agriculture. Farmers' Bulletin No. 1863: The Turnip Aphid in the Southern States and Methods for its Control. By Norman Allen and P. K. Harrison. Pp. ii+10. 5 cents. Technical Bulletin No. 749: Composition of the American Gum Turpentine exclusive of the Pinenes. By T. C. Chadwick and S. Palkin Pp. 16. 5 cents. (Washington, D.C.: Government Printing Office.) [165

Royal Observatory, Hong Kong. Magnetic Results, 1939. Prepared under the direction of C. W. Jeffries. Pp. 51+2 plates. (Hong Kong: Royal Observatory.) 1 dollar. [165

Records of the Geological Survey of India. Vol. 75, 1940, Professional Paper No. 7: Classification of the Gondwana System based on Vertebrate Faunal Evidence. By N. K. N. Aiyengar and M. S. Venkataram. Pp. 14. (Calcutta: Geological Survey of India.) 4 annas; 5*d*. [195

United States Department of the Interior: Geological Survey. Water-Supply Paper 847: Maximum Discharges at Stream-Measurement Stations, through December 31, 1937. By Gordon R. Williams and Lawrence C. Crawford. With a Supplement including Additions and Changes through September 30, 1938, by William S. Eisenlohr, Jr. Pp. iii+272. (Washington, D.C.: Government Printing Office.) 30 cents. [205

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ORGANIZATION OF CIVIL DEFENCE

THE Government decision to transfer the fire-fighting organizations from the control of local authorities, and to re-group and reinforce them under the general control of the Ministry of Home Security, thus establishing a national fire-fighting service, has been generally welcomed. The debates in the House of Commons indicate that the Reorganization of the Fire Services Act gives expression to a principle which is regarded as essential by all who have had first-hand experience of heavy air raids and which has already found firm advocacy in various reports and inquiries, from the P E P Broadsheet "London under Bombing" to the recent fourteenth report of the Select Committee on National Expenditure.

Inevitably the whole question of civil defence administration is raised by a change of this magnitude, and the report of the Select Committee makes an important and opportune contribution to such discussion. The decision to base the administration of the fire services on the twelve Civil Defence Regions and as many sub-regions as efficiency requires involves important detailed reforms—the separation of the administrative from the executive side of fire-fighting, the appointment of recognized and recognizable chiefs to whom reinforcements can report on arrival in a heavily bombed area, and the strengthening of the fire-fighting army by the allocation to it of some of the men called up under the National Service Act. From such reforms it should be a simple matter to use regional authority to implement the main recommendations of the Select Committee in this field.

The more important of these recommendations are clearly matters in which regional authority can best help. A systematic attempt to ensure that all brigades should be given experience of fire-fighting under air-raid conditions; the revision of the fire-fighting orders and the securing that fire-fighting parties are really efficient; the standardization of hours of duty of firemen and improvement of accommodation; the development of the Supplementary Fire Party Service and its relation to the strength of the Auxiliary Fire Service, and measures to improve water supplies, are all matters in which local authority or experience alone has been and is inadequate.

While it remains to be seen whether the Ministry of Home Security and the Regional Commissioners in different circumstances will receive the complete planning and the scale of equipment and personnel which will be adequate to bring sufficient forces to bear in time anywhere and everywhere the enemy may attack, it is significant that the Select Committee goes beyond the Government's present plans in contemplating no divorce between fire-fighting and fire-prevention. The trend of the report suggests that it is unlikely to countenance as adequate the immediate step of placing Miss Wilkinson, the efficient Additional Parliamentary Under-Secretary to the Ministry of Home Security, in charge of the training and equipment of the fire-fighting and fire-watching groups. It scarcely appears to give such parties the status, training and discipline of other Civil Defence Services as recommended in the Report, or to provide the nucleus of paid whole-time workers regarded as essential.

The importance of staff work in this field has not yet been fully appreciated, nor the two functions—that of the general staff officer and that of the officer in the line—clearly recognized. The chiefs of the various fire regions must be selected primarily for their administrative ability, while the Select Committee points to the necessity of also staffing key positions in constantly raided areas which involve continuous administrative duties with full-time workers chosen for such ability. Thorough training of the fire watchers and bringing this service to its full efficiency by the wise use of compulsory powers and establishment of close relations with the other fire services has an important bearing on the strength of the Auxiliary Fire Service.

While it is now recognized as beyond question that in any field of civil defence planning within the administrative boundaries of individual local authorities is disastrous to efficiency, the Select Committee does not consider that this alone is sufficient. Regional authority may be adequate to move unhesitatingly where required more than one third of a force from an area and to see that such reinforcements are adequately directed both *en route* and in action. Something more than regional authority is required, however, if the most efficient balance between whole-time and part-time personnel is to be secured.

Such matters as these involve the general question of man-power policy and the use of the powers of the Defence Regulations or relations with other Government Departments, and for these reasons the Report recommends further consideration of the concentration of all civil defence functions in a single Ministry. In particular the administration of all the civil defence functions of the Ministry of Health should be delegated to regional commissioners. Some of the shortcomings have been due to fundamental weaknesses in the administrative machine, such as lack of control by the central department. While the regional organization has avoided delay in reaching local decision, it has frequently failed to preserve control of policy. Its co-ordinating functions, particularly at the level of the central departments, through failure to see the problems of civil defence as a whole, have been seriously hampered by the division of responsibility between the Ministry of Home Security and the Ministry of Health or the Department of Health for Scotland, and the difference in the extent of departmental devolution for different services.

Co-ordination of the various Civil Defence Services and also economy, by avoiding duplication of inspectorial and administrative staffs, would be facilitated by the delegation to the Regional Commissioners of the administration of all the civil defence functions of the Ministry of Health and of the Department of Health for Scotland (with only such limitations as necessarily apply to the hospital services and evacuation). If, however, civil defence could be organized *de novo* it would undoubtedly be placed under a single Minister unburdened with other responsibilities, and the wisdom of this solution is well attested by the detailed recommendations of the Report, which so often reiterate proposals advanced elsewhere by Political and Economic Planning and other bodies. Moreover, strong support for the appointment of a single Minister of Civil Defence has been forthcoming from other quarters as indicated by press correspondence and articles.

There is, moreover, a further aspect of this question of Ministerial co-ordination which may be of importance in post-war developments of regionalism. Despite the impetus which the War has given to regionalism by revealing the weaknesses and limitations of local government, there does not appear to be any hostility on the part of the local authorities to regionalism. On the contrary, generally speaking, a happy co-operation has been established between the regional commissioners and the local authorities, and machinery at both ends has been improved and adjusted to meet constantly changing problems. Regional commissioners have rarely found it necessary to exercise their powers of superseding an inefficient local authority in its civil defence functions. Local authorities, however, were not designed to deal with the conduct of what the Home Secretary has described as a "military operation" on a large scale, and the closest co-operation between them can be no substitute for either regional or national control.

While, therefore, we may well hope that the stimulus to regionalism in civil defence or in other fields given by the War may prove invaluable in educating local authorities and public opinion as to the value of a regional approach to numerous other problems such as water or power supply, transport, land utilization, and the like after the War, it should not be forgotten that in a democracy regionalism is itself an instrument developed to meet particular conditions, and that it must satisfy the democratic conditions of flexibility and responsibility. It may well be necessary to extend the powers of the regional commissioners as part of the administrative machinery of military defence, for which local government cannot be expected to be suitable, and to make those powers more concrete in respect, for example, of food, evacuation and transport. If that is done, however, the question of public responsibility of the Commissioners becomes the more important under any democratic system.

To place the Commissioners under a single Ministry responsible to Parliament should go far to facilitate co-ordination and central control of policy and to meet the criticism of responsibility which has sometimes been advanced. Such a step might well ensure the fullest efficiency and dispel the uneasiness which may attach even in war-time to the entrusting of such wide powers to single individuals, in contrast to regional organizations, divorced from local responsibility in fields which have hitherto been administered largely from that point of view. We cannot afford even in war-time to overlook the importance for developing a democratic system, adequate to meet post-war demands, of continuously educating public opinion as to the issues involved and of digging the channels of assent to future changes or developments.

Apart from this broad question of administration, the Select Committee's report emphasizes the way in which the question of civil defence is linked up with the most efficient use of our man-power and woman-power. Its proposals for reducing the requirements of man-power for the Civil Defence Services are based on the experience which has now been gained of heavy raids, notably the outstanding fact that the loss of life and injury to persons has been much less than was expected, while material damage has been greater. Generally speaking, the Fire and Rescue Services have proved no more than adequate and in a few places actually deficient. Casualty services, on the other hand, have generally proved ample to meet the demands made upon them, and the Committee accordingly has been able to recommend reductions in the strength of these services.

Its main general recommendation for reducing the requirements of Civil Defence for man-power is the recruitment of part-time unpaid workers. Whole-time personnel should only be resorted to when part-time personnel cannot be obtained by voluntary recruitment or by compulsory enrolment under Defence Regulation 26A. In particular, the air-raid wardens' service should substantially revert to its original part-time basis and the paid element, so far as possible, be eliminated. Increase of the part-time element in the Report and Control Centres by encouraging the recruitment of business men and officials is also recommended, as well as consideration of the possibility of strengthening the Rescue Service by enlisting the building trades as a whole in an area for part-time service at normal rates of wages.

Other suggestions for saving man-power include the reduction of day-manning strengths to the minimum consistent with safety; the establishment of mobile reserves of rescue parties; the intensive review of operating methods and the review and reduction of the number of ambulances and first-aid posts in the light of present experience. Severe criticism is passed on the Emergency Hospital Scheme for the absence of information which would enable any judgment to be reached as to whether nursing staffs are excessive, and the interchange of nursing staff between standing-by and hard-pressed hospitals is recommended.

Other severe criticism is passed on the shelter policy, the absence of standards, and the giving to the regional commissioners of a discretion amounting to control of policy. The amount of shelter, public and domestic, to be provided in less vulnerable areas should be clearly laid down according to a standard, and the places where shelter is to be provided should be determined on a definite classification of areas according to vulnerability. The administrative responsibility for the provision of all kinds of industrial shelter should be placed upon the regional commissioner and his technical staff.

These recommendations alone indicate how close and searching a scrutiny the Select Committee has made of the organization of civil defence, and how truly thinking minds have surveyed these problems. The Report indicates, indeed, that the right type of organization has been evolved, in the regional commissioners, to deal with the emergency problems which arise in heavy and sustained raids, calling for rapid, decisive directions. It is for our representative institutions to attest once more the swiftness of their capacity to respond to constructive criticism, to remedy proved weaknesses, and to strengthen and extend where required to such fields as food supply, housing, evacuation, transport and other services which may be required to deal with the social effects of severe attack, the co-operation and co-ordination which regional and central authority have been proved able to secure. Democracy must prove its fitness by its ability to learn from experience and its swiftness in applying that experience to meet changing needs.

RUTHERFORD—THE HERO AS MAN OF SCIENCE

Lord Rutherford
By Dr. Norman Feather. ('O.M.' Series.) Pp. x + 195 + 8 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 5*s.* net.

RUTHERFORD'S grandfather had been one of the early settlers in New Zealand. His father owned and lived upon a flax farm in a rural district of South Island. Ernest, born in 1871, was the second son and fourth child in a family which was large, even by the more exacting standards of seventy years ago. At the time of his birth the white population of New Zealand was little over a quarter of a million, and twenty years earlier it had been little more than a tenth of this. Nevertheless, owing to the progressive spirit of the early settlers and to their interest in education, Rutherford was able to receive a more than adequate grounding in science, and even to undertake original research, before he left the country at the age of twenty-four.

He entered Nelson College in 1887 from the State school at Havelock, as the holder of a Board of Education scholarship, and in 1890 he proceeded to Canterbury College, Christchurch, with a scholarship awarded by the University of New Zealand. In 1895 he arrived at Cambridge, the award of an 1851 Exhibition Science Scholarship having enabled him to seek wider opportunities for research. He had then already carried out promising experimental work in electromagnetism, and begun experiments on Hertzian waves, using an ingenious magnetic detector of his own designing.

Rutherford resumed these experiments in Cambridge, with outstanding success, but soon became attracted to the new subject of gaseous ionization and a little later to radioactivity, which became his life-work. The pioneer work on gaseous ionization, which he did in collaboration with J. J. Thomson, was important enough in itself; to Rutherford, however, its main importance was that it provided a natural stepping-stone to the study of the α- and β-rays, which he discovered in 1898. At this stage his work was interrupted—but, characteristically, only by the barest minimum of time required for travelling—by his departure to Montreal, where he succeeded Callendar in the Macdonald research professorship of physics at McGill University.

The rest of Rutherford's life was spent in the successive occupancy of three important chairs—nine years at McGill, twelve in Manchester, and just over eighteen in Cambridge as Cavendish professor. The outstanding contributions he made to physical science in these three periods are now well-known chapters in the history of science; McGill saw the birth of the theory of radioactive transformations and the elucidation of the main radioactive series, Manchester the beginnings of the nuclear atom and the first experiments on nuclear disintegration, and Cambridge the development of the large-scale attack on the problem of nuclear structure.

Rutherford came at an unusually early age to be recognized as one of the great leaders of physical science. He was a tremendous worker, and his unflagging enthusiasm served as an inspiration to steadily increasing numbers of physicists who were attracted to his laboratories, and to generations of students whom he trained for research. Much of the experimental work which established his views on atomic and nuclear physics was carried out in his own laboratories—in the earlier days a great deal with his own hands and with the simplest of apparatus. He was above all a great experimental genius, and he seemed to progress without effort from the use of electroscopes made with cigarette tins to the large-scale heavy electrical apparatus necessary for modern nuclear research. He had a genius, too, for acquiring money and materials for the work he wanted to do, and perhaps in his later years too much of his time and energy were occupied in getting and spending of this kind. This was in striking contrast to his lack of interest in money for its own sake; so far as concerned his personal finances, he was uncovetous and disinterested almost to the point of eccentricity.

The progress of his scientific work was punctuated by an unusually large share of academic and official honours—and Rutherford quite frankly and fully enjoyed all that came to him, and liked his friends to rejoice with him. Honorary degrees and memberships of learned societies from all over the world were showered upon him. He was elected to the Royal Society in 1903 (serving as president during 1925–30), he received the Nobel Prize (for chemistry) in 1908 and he was knighted in 1914. He was awarded the Order of Merit in 1925 and raised to the peerage, as Baron Rutherford of Nelson, in 1931, thus receiving the highest heritable honour accorded to pure physics in England (so far accorded very infrequently, and never yet to a physicist with male issue). He was president of the British Association in 1923, and but for his tragically sudden death he would have served as president of the Indian Science Congress in January 1938.

A career like Rutherford's lends itself obviously —indeed, too obviously—to biographical treatment in a wide variety of styles, from the coldly scientific to the sensational pseudo-scientific, passing by the way the morally uplifting (Samuel Smiles and "Log-Cabin to White House" are models which leap to the mind). The "O.M." series, to which the present volume belongs, dictates a moderately severe, though not too technical, kind of treatment, and does not entirely exclude the element of moral uplift. The author is at pains to point out that his "emphasis all through is on Rutherford the Scientist". This is obviously where Dr. Feather's preference would in any event lie, especially as the details of Rutherford's life, and much of his correspondence, are already available in Eve's official biography published by the Cambridge University Press (see NATURE, March 2, 1940).

By following the plan thus indicated, Dr. Feather has succeeded in compressing into a quite small volume a remarkably complete account of Rutherford's main achievements and, more important still, a connected study of the development of Rutherford's ideas and of the way in which he contributed so largely to the changing of the whole face and trend of atomic physics. Chapter i, on "The Outlook of the Scientist", is an excellent introduction which will help the general reader to an appreciation of the ways in which Rutherford's work impinged upon and modified contemporary scientific thought.

Fortunately, in spite of obvious restrictions of space, Dr. Feather has not entirely suppressed "Rutherford the Man" in favour of "Rutherford the Scientist"; indeed, as Sir William Bragg hints in his foreword, in Rutherford the complex of man and scientific worker was never very completely dissociated. The reader should therefore get from this little book a very fair impression of the combination of qualities which made of Rutherford so inspiring a leader. Indeed, much may be learnt from the well-chosen illustration facing page 186, a snapshot of Rutherford in the laboratory, "discussing the day's results" with two research men. This (fortunately) is much more characteristic of Rutherford than the portrait facing page 128.

Dr. Feather's interest in the history of science and his intimate knowledge of, and association with, much of Rutherford's work have enabled him to do full justice to his theme. It is one of the most fascinating stories in the history of physics—all the more so because Rutherford's mind, far more than that of most men of science, seemed at times to work quite intuitively. Nearly all his life he was doing pioneer work in virgin forests, and the magnitude of his completed performance would have been much less if he had not possessed a remarkably shrewd physical insight which preserved him from wasting time and effort in 'barking up the wrong trees'. Dr. Feather has said this, and more, in much more elegant fashion; the reviewer has ventured to express it in the words which he thinks Rutherford would himself have chosen.

This is a book that was well worth writing, and Dr. Feather is to be congratulated upon and thanked for the way in which he has written it.

H. R. ROBINSON.

EDUCATION OF THE FUTURE

The Future in Education

By Sir Richard Livingstone. (Current Problems.) Pp. ix+127. (Cambridge: At the University Press, 1941.) 3*s*. 6*d*. net.

SIR RICHARD LIVINGSTONE has made a notable contribution to educational thought, although he himself would disclaim any suggestion of originality in his views, since his inspiration comes principally from the writings of Plato, Aristotle, Shakespeare and Milton, together with the main teachings of Christianity. He is concerned only incidentally with the organization of education, but in a style remarkably pleasant and illuminating he deals with those problems which are almost eternal. Work in the schools, he says, is merely preparatory for what should come later as experience accumulates and as the mind expands to comprehend ideas which are complex in themselves and of deep significance, such as we find particularly in social questions, policies and philosophy. He attaches great importance to the fertilizing influence which experience exerts upon knowledge. Too many ideas, which Whitehead would term inert, are plastered on to the young mind, only to fall off again; while even undergraduates are not yet mature enough in their experience of life to comprehend fully the information with which their minds are loaded.

Many of the views to which the author gives expression in his earlier chapters should be taken to heart by teachers of science. Only too frequently their conception of what should constitute a liberal education becomes lost beneath a mass of facts and of abstract principles which fall right outside the student's own experience, and which have no immediate bearing on human life, whether we are thinking of their technical application, or more especially of the wider field of general thought. Whole masses of detail might be jettisoned from science text-books, making room for broader and more entrancing vistas, with a great gain in educational efficiency, and considerable relief to the mind, particularly in the case of those students who will never take up science in any vocational sense ; and, after all, these pupils are the real testing-ground for the educational value of science.

Having indicated what in his opinion are the chief deficiencies in our present system of education, Sir Richard Livingstone then proceeds to suggest possible remedies. A first essential would seem to be part-time education for all until about the age of eighteen. But a far greater need is for the expansion of facilities for the education of adults who from their own experience are in a position to appreciate the ideas and forces which control and determine their existence. Something of this kind has already been achieved by such organizations as the Workers' Educational Association, the Women's Institutes, the Community Centres and the various Guilds, but at present their work is conceived on too narrow a basis, lacking both cohesion and continuity. In their place the author would like to see something analogous to the People's High Schools in Denmark, which, designed entirely for adults, are residential, non-vocational and essentially a spiritual force. Yet, in attributing much of the recent social and economic progress in Denmark to the People's High Schools, Sir Richard Livingstone has not given sufficient weight to the special conditions obtaining there, particularly when the schools were first set up. As he admits, they have made little progress in the towns only a few miles away, and there really is a good deal less work on the farms in Denmark in winter. Besides, Holland has experienced a similar economic development without the aid of such schools, and in Great Britain the public schools with comparable educational ideals have done little to foster any spirit of co-operation.

Nevertheless, the idea of establishing some form of adult schools in Great Britain deserves careful consideration. Industrial conditions now stand in their way, but they might develop most easily as an outgrowth of our Summer Schools. Liberal ideas are more likely to take root in a residential and social atmosphere, with a tinge of the recreational, and one in which the needs of exact scholarship are not so pressing. It might then be possible to link these schools up with other organizations catering for the already educated adult. The present system of summer schools and conferences for professional people the author would like to see extended to cover all those who, passing beyond middle life, and often holding important offices, are in danger of mental ossification and need to be kept abreast of the times.

So far Sir Richard Livingstone has won and retained our admiration for the lucidity with which he has presented his thesis, the major part of which has our unqualified support. It is when he turns to the means and ends of education that grave doubts arise. While not wishing to banish science, mathematics and modern languages from the curriculum, he accords to them a subordinate role, particularly for adults, since, he maintains, they are concerned more with the means by which man lives than with man himself. But "before the student of literature, philosophy, and history are displayed *all* the forces and ideas that governed man, personal, religious, or political". Here his judgment seems to have deserted him. History, literature and politics we can only see through the window of the present, in colours ever changing with the progress of scientific investigation. In isolation these subjects have no personal centre of gravity. What poem or poet are we to take as our standard, what character in history, or philosophical principle as our guide ? That a poet enriches life everyone will concede, but that he sees more deeply and more nearly to the truth than other men is a very doubtful proposition, for on such a subject as a sunset in Italy there could be as many different poems as there are poets. No one has yet discovered what poetry really is.

This leads us on to a consideration of the final ends in education. These the author maintains have been stated many times in the world's history, and are to be found at their best in Greek thought and in the Christian faith. They might be summed up in the conception of the Supreme End, something similar to what Milton had in mind when he wrote, "To know God aright and out of that knowledge to love him, to imitate him, to be like him as we may the nearest, by possessing our souls in true virtue." Here Sir Richard Livingstone presents his case with a serenity of mind singularly out of touch with the profound spiritual questionings which beset the modern world. To many of us Milton's words appear as great literature, but their relevance to present-day problems is distressingly vague. For centuries now scientific investigation has been at work altering the basis of fact upon which the general principles of politics, philosophy and moral conduct are based, and with them the detail of their application. As the reviewer of J. S. Huxley's latest book recently stated in *The Times Literary Supplement* of April 12: "Naturally the science of theology needs restatement from time to time in the light of new facts." Where then is the tangible basis, except in the facts, which themselves are subject to constant revision? Faced with the spiritual morass of the present times it is hopeless to look for salvation to the past. Parents and children cry for new subjects in the curriculum, while the Churches empty, not because the people have gone astray, but because the interpretation of knowledge fails to keep pace with its accumulation. Sir Richard Livingstone, who expresses a great admiration for Masaryk, would find this point elaborated far more ably if he would turn to Masaryk on "Thought and Life".

R. Weatherall.

THE SPIRIT OF ANALYSIS

A Text-Book of Qualitative Chemical Analysis
By Dr. Arthur I. Vogel. Second edition. Pp. xi+486. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1941.) 10*s*. 6*d*.

Students of chemistry usually begin their working lives with the study of qualitative analysis, carried out too often in crowded laboratories with inadequate equipment: it is the equivalent to "grubbing weeds from garden paths with broken dinner knives". Such education is supposed to make "better men than you or I" doubtless because of its practical basis, but to-day we are sufficiently enlightened to wed practice with theory from the beginning and to realize that the more one understands what one is doing the greater the interest in the task becomes.

The writer, like many others, began to learn analysis with an unknown substance before him and a set of tables full of horrible abbreviations which was followed meticulously. He learnt many facts but little manipulative skill and there was no time for reasoning. When Ostwald's famous and best book came into his hands a few years later it was a revelation; nearly everything had been missed during a dull period when chemistry had appeared unattractive. Manipulative skill, the first essential of a would-be researcher, had to be learnt during organic preparations.

The moral of all this is that qualitative analysis has a true spirit and it must be taught in such a manner as to cultivate this. The reviewer is evidently not alone in holding this view for it is the basis of Dr. Vogel's text-book, which has passed into a second edition in little over two years and has been praised by teachers and reviewers. The new edition contains many additions which add to its completeness and value, such as extended accounts of spectroscopic and of microqualitative analysis and of spot tests, all of which are proving helpful in days when the chemist ventures greatly with the smallest possible quantities of materials.

Analytical chemistry, though the oldest branch, and forming a profession of its own with proprietary rights and a society of high standing, is yet neglected academically. There is no professorial chair in the subject in England, as the President of the Institute of Chemistry has just emphasized, announcing at the same time that the subject now forms a branch in which candidates for the associateship of the Institute can be examined. We have emphasized the importance of skill at the bench and it is much more so in these days when work is on the microscale in relation to the natural substances which are being studied. The many Englishmen who worked in Germany forty years ago, often with the aid of an 1851 Exhibition, were almost without exception far more skilled in bench dexterity than the German students whose education in analysis had been on similar lines. In passing, it is interesting to note that nearly all the young men who to-day appear as authors of outstanding researches or books of merit are on record as holders of one or other of the various research fellowships now available. There is much evidence that these are fulfilling their purpose.

There is no point in any detailed reference to Dr. Vogel's pages—practice and theory are so intermixed that one can open the book almost anywhere and read a few pages or paragraphs with interest. The subject is shown to have a soul, a purpose as well as a body—the manipulations take on the guise of an art and a craft instead of being mechanical operations. We have the feeling we would like to begin chemistry all over again.

One last word—these necessities, for they are far more than ideals, mean bigger and better laboratories and perhaps smaller classes. Governing bodies must be educated that laboratories are more useful than lecture theatres, and that theory may be taught at the bench though practice is not learned by listening to lectures alone.

E. F. Armstrong.

(1) Some Problems in Adsorption

By J. K. Roberts. (Cambridge Physical Tracts.) Pp. x+120. (Cambridge: At the University Press, 1939.) 7*s*. 6*d*. net.

(2) Magnetism and Very Low Temperatures

By H. B. G. Casimir. (Cambridge Physical Tracts.) Pp. viii+94. (Cambridge: At the University Press, 1940.) 6*s*. net.

(1) THE first of these little volumes deserves notice because its author writes with first-hand knowledge of his subject and because it is such a helpful survey of experiments and results which do not appear to be conveniently collected elsewhere. Our views on adsorption processes are changing so rapidly that this tract might well be used as an introduction to the more recent treatment of the subject by the author in his article in the current issue of "Reports on Progress in Physics", vol. 7. This combination will provide the reader with an excellent account of the present state of the subject.

(2) The second tract is likewise written with expert knowledge of its subject-matter. It reviews the methods of producing and results of adiabatic temperature changes obtained by demagnetization processes with paramagnetic salts at very low temperatures. It includes a valuable theoretical discussion of the behaviour of paramagnetic ions with special reference to the Lorentz and Onsager fields, and a short account of the theoretical aspects of relaxation phenomena in paramagnetics.

L. F. B.

University Physics. Part 2: Heat

By Dr. F. C. Champion. Pp. vii+148. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1940.) 5*s*. 6*d*. net.

AS the second volume of a series of books primarily intended for students taking a first- and second-year course in physics at a university, one scarcely expects to find space taken up with references to elementary work which has no doubt been done by a student at a much earlier stage; such space could probably have been used to better advantage. Thus in the first chapter mention is made of various types of thermometers, but a description and discussion of these types is deferred to a later part of the book; surely this must be a little irritating to students. Also the table on pp. 8–9 comparing the various thermometers would probably be better appreciated after all the thermometers had been dealt with. The treatment of the various topics follows a logical order, though probably the chapter on radiation could have followed immediately that on conduction.

The above observations are not meant to detract from the merits of a really useful book, which is sound and attractively produced. The diagrams throughout are good and clear, and the chapter on thermal conductivity is especially good.

Dr. Champion makes an excellent point in stressing the importance of reading widely to acquire experience of different methods of treatment, and it is good to realize that there is a tendency towards less formal lecturing, and more study on the part of students; the art of study should be developed and encouraged.

Experimental College Physics: a Laboratory Manual

By Prof. M. W. White. Second edition. Pp. xvi+383. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 19*s*.

THIS rather high-priced book, which is beautifully bound and produced, is a laboratory manual not apparently designed to cover any special examination course, but it appears to be quite suitable for students of post-matriculation standard. All branches of physics are represented in the course (though the section on sound is rather thin), and if a student has the time and the facility to deal adequately with the point raised in each experiment, the course should prove a most valuable one. The book is not merely a compilation of directions for performing experiments, but it includes also the theory underlying each experiment, a description of the apparatus needed, and suggestive questions and problems. An especial emphasis is quite rightly placed upon the evaluation of errors involved in the various experiments, and the whole course certainly encourages a student to appreciate the possibilities and limitations of the scientific spirit and method of investigation.

In some experiments rather specialized apparatus not likely to be found in all laboratories is used, but such apparatus, which in certain cases is rather ingenious, is designed for precision results; in a course of this standard this may not be altogether a desirable aim.

One is struck by the thoroughness with which the task has been attempted, and there can be no doubt of the tremendous enthusiasm of the author for his work.

Economic Geography of South America

By Prof. R. H. Whitbeck, Prof. Frank E. Williams, assisted by Prof. William F. Christians. (McGraw-Hill Series in Geography.) Third edition. Pp. xi+469. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 24*s*. 6*d*.

SOUTH AMERICA offers great scope for economic development from the European point of view. Too much that is written about that continent has a commercial bias or a political colouring. Thus a purely objective study has much value to students. The present volume is nominally a second edition, but in reality is largely a new book. The survey has been done with much care, with due emphasis on the physical and climatic background, which explains much of the economic geography of the South American republics. Most of them are exporters of raw materials and food and importers of manufactured goods, and thus are of great importance to industrialized lands. Lack of population and undeveloped power resources so far restrict manufacturing activity, but even this is tending to develop, and in time to come South America may be more self-contained than at present.

The book is well balanced and well informed, though perhaps more space might be devoted to an account of the racial ingredients of the population. Surely also the little colony of the Falkland Islands merits a few pages.

BIOLOGICAL ADAPTEDNESS AND SPECIALIZATION OF INSTINCTIVE BEHAVIOUR*

By Dr. E. S. Russell, O.B.E.

INSTINCTIVE behaviour is to be regarded, from the biological point of view, as one of the means through which the animal fulfils the biological ends of development, maintenance and reproduction. Now as each species of animal fulfils these ends in a particular way, being after its kind a functional and ecological specialist, we may expect to find that its instinctive equipment, its predisposition to particular perceptions and actions, is also specialized and adapted to its functional requirements, and to the particular environmental complex in which the species normally lives, at different stages of its existence.

It is usual to think of 'adaptation' or adaptive specialization in terms especially of the visible 'characters' of the animal such as its protective coloration. But this is clearly a very superficial view. It is, quite obviously, the animal as a living entity, throughout its entire life-cycle, including reproduction, that is 'adapted' to environment, and if a sufficient number of individuals were not so adapted, the species could not survive.

Adaptation, or adaptive specialization, is therefore not simply a matter of superficial 'characters', such as may be supposed to have 'survival value', but of the behavioural, physiological and morphogenetic activities of the animal throughout its whole life-cycle. Adaptive specialization rules throughout the whole life-history. There must be no weak link in the chain, otherwise the species disappears.

Consider the main points in the life-history of parasitic Hymenoptera (families Chalcididæ, Braconidæ, Ichneumonidæ). These insects having taken up a highly specialized mode of existence, have occupied a very special ecological niche, for they pass their larval stages in the living bodies of various insect hosts, parasitizing them in the caterpillar or chrysalis stage and in some cases in the egg itself.

If the parasite species is to survive, the sexes must be able to find one another and effect the fertilization of the egg; the female must be able to find and oviposit in a suitable host—a host in which her larvæ can survive and develop. She must have the necessary organ for inserting her egg into the body of the host, a sharply pointed ovipositor, and the impulse to plunge it in. In its turn, the larva must be adapted in structure and physiological functioning to live and grow in the very special conditions afforded by the interior of the host. That it is so adapted and specialized is well illustrated in the excellent description given by Cameron[1] of the larva of the ichneumon *Glypta hæsitator*, a parasite of the caterpillar of the pea-moth *Cydia nigricana*, in which he directs special attention to the adaptations in the cephalic skeleton and jaws. This apparatus is more developed in the first and fourth stage larvæ than in the second and third; in the first stage it is required for the act of eclosion from the egg, and in the last stage for feeding on solid food. "In the earlier stages," he writes, "the parasite larva obtains nutriment in a fluid condition, but in the last instar it has to live mostly on solid food, consisting of the remaining tissues of the host, such as the fat-body, etc., and for this work it requires stronger mandibles and a stronger supporting skeleton. Stronger mandibles are also useful when the time comes for it to break through and cast off the skin of its host. The arduous task of cocoon spinning is carried out in this stage. The latter function is specially provided for by the transformation of the salivary gland and its opening into a silk gland and a spinneret, respectively. . . . In the second and third stages the cephalic skeleton is present, but the parts are only weakly chitinized, from which it would appear that it has no special function to perform save that with each moult the parts get successively larger in preparation for the work awaiting them in the final stadium."

Here we have an excellent example of that proleptic or anticipatory formation of special structures to meet coming needs which is so striking a feature of the directive process of development; and it seems clear that without these special provisions, and many others of an adaptive kind, the larva could not successfully carry through its development.

Turning now to the behavioural adaptations concerned in the finding of a suitable host, we see at once their vital importance for the continued existence of the species. From the very fact that a parasite species continues to exist we can infer that a sufficient number of females manage regularly to find and oviposit in suitable hosts. They must have therefore the impulse to seek for such hosts, and the power to recognize them in some way, by their specific smell, or by their size and shape and texture, or by some other characteristic. Every species that persists and maintains itself successfully must be, as regards its females, biologically adapted and specialized to find and parasitize a host or hosts in which its offspring can develop normally. Some species limit themselves to a single kind of host ; others successfully parasitize a large number. There are therefore degrees of specialization or restriction.

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* Substance of the presidential address before the Linnean Society of London on May 24.

Let us consider the nature of this instinctive predisposition. It seems unreasonable to suppose that the ovipositing female is guided in her choice by explicit knowledge that such and such a host is a suitable one for the development of her egg, and acts with intelligent purpose. She knows nothing of her egg *qua* egg, that is, as something which will develop into a larva and adult ; it is to her merely 'something to be laid'. She can know nothing of the nutritive relations that will be set up between her larva and the host. The animal seems inconceivable that the female can have such knowledge ; she is an insect, not an entomologist. The fact that instinct can err and is easily led astray in abnormal or unusual situations is sufficient to show that no supernatural faculty of direct intuitive knowledge is involved, as Bergson believed.

We see then that instinctive behaviour is not a matter of the intelligent and purposive pursuit of ends ; it is a matter of specialized and pre-adapted capacity—the capacity or predisposition to perceive certain things and events, and to act in a particular manner with reference to them. It knows what to do about them, though it does not know why. As Spaier[2] has well said, instinct is characterized by *savoir faire*, as distinct from *connaissance*.

Instinct is specialized on the perceptual side as much as on the executive. The female having the instinctive disposition to seek out a particular host is guided by some perceptual clue which is normally associated with that host alone, and this clue may be both simple and normally adequate—a specific smell for example, associated with an object of a certain size and shape.

The chalcid *Microplectron fuscipennis*, for instance, is restricted in her attacks to the resting larva of the saw-fly Diprion, which is enclosed in a cocoon[3]. She does not, however, seek what we think of as 'a cocoon of Diprion' ; she cannot form a concept such as this ; she simply seeks an object (or manipulandum, as Tolman would call it) which is attractive to her as 'something to be pierced' with her ovipositor, an object that has this particular functional valence.

She is able to distinguish this object from other similar objects, by means of a few sensory characteristics, such as smell, shape and texture, which are not necessarily those which we perceive as diagnostic of a Diprion cocoon. She is adapted and specialized in her sensory capacities in such a way as to perceive and be attracted to certain specific objects (which are biologically suitable for the development of her eggs), and to be impelled to oviposit in them, in preference to other similar objects. Such objects alone have for her oviposition valence.

This specialization and adaptedness of instinctive behaviour on the perceptual as well as on the executive side is obviously just one aspect or expression of the adaptive specialization which characterizes the individual and the species as a whole.

Correlative with the fact that animal species are adaptively specialized is the fact that they normally live in a more or less definite and specialized environment or ecological norm, which is optimal for their vital requirements. This may be extremely restricted, as in the case of caterpillars which feed on one kind of plant, or live in a specialized environment, as do the leaf-miners ; or it may be very wide, as in the case of many far-ranging birds and fishes. It is impossible to define it except in terms of the functional needs and requirements of the species, with which it is correlative. It may alter radically in the course of the individual life ; many teleostean fish completely change their habits and habitat when they change over from a free-floating planktonic existence to a life on the bottom of the sea, and drastic changes in life-habits and the ecological norm are notoriously shown by holometabolic insects.

It is a very interesting problem of animal behaviour to determine how a species finds and remains in the ecological norm appropriate to each particular stage of its life. This is too big and comprehensive a question to be tackled here in detail, but I propose to consider in outline some of the ways in which animals contrive to lay their eggs in the special ecological norm which is suitable for their development.

In the simplest case, the animal deposits its eggs within its own ecological norm ; the pond-snail Lymnea, for example, lays its gelatinous masses of eggs on the vegetation of its home pond ; many shore fish, like the blennies and gobies, fix their eggs in crevices of the rocks within their normal habitat. But it often happens that the ecological norm for the eggs and larva is quite different from that of the adult ; especially is this the case with insects that undergo metamorphosis, and with marine animals that have pelagic larvæ. In such cases the female usually selects for oviposition either the ecological norm required by the larvæ or a place from which this norm can be reached. An insect, for example, may oviposit directly on the food plant of its larva, or on the substance, such as dung or carrion, on which the larva feeds. If it has an aquatic larva it may oviposit on the surface of the water, like many dragonflies, or it may insert its eggs in plants growing in or near the water. Many marine fish normally spawn up-current, in such a position that their floating larvæ are usually drifted down towards an area in which they find suitable conditions for their later development and growth[4].

Here are two examples of the selection by insects of the *general* environmental conditions required by their larvæ. A species of tsetse fly, *Glossina palpalis*, found on the shores of Victoria Nyanza, feeds by preference on reptilian rather than mammalian blood; it is most numerous on the open beach and banks of streams which crocodiles and Varanus frequent. Here also are found its pupæ in greatest numbers, adjacent to the food supply when they hatch out. Hale Carpenter[5] made a careful study of the exact locations where the females deposited the mature larvæ they produce. He concluded that they sought out with great accuracy areas of loose, dry soil, well shaded, with a surface exposed to the air, within a few yards of high-water mark, but beyond the reach of the water.

Similar care in the selection of a suitable place in which to lay her eggs is exhibited by the flying imago of the ant-lion, *Myrmeleon formicarius*. On warm summer evenings in the twilight the females are to be found flitting round the sun-warmed sandy spots where were situated the funnels in which they lived as larvæ[6], and in these areas they deposit their eggs. These spots must be warm and dry and sunny, preferably sheltered from the rain by an overhanging bank or tree, and floored with sand or dust in which the larvæ can dig their conical funnels. If the female chooses an unsuitable spot, the larvæ on hatching will move about until they reach their proper ecological niche, guided by light and temperature.

Selection of a position for egg-laying from which the young will normally reach their ecological niche is well illustrated by the cicadas. In their immature state, which may last for many years, as in the famous 'seventeen year locust', these insects live underground, in narrow vertical shafts, getting their food by sucking the juices of roots. When the time comes for metamorphosis, the nymphs emerge from their burrows in the late spring, and immediately seek out some plant or tree, which they climb and to which they cling, while they burst out of the nymphal shell as fully formed imagos. *Magicicada septendecim*, according to the careful investigations of Andrews[7], treks steadily and persistently towards the nearest tree—which it perceives visually, not as a complex thing such as a tree appears to us, but "as an area of greater or less light contrasted with the background". If it is prevented from reaching a tree it will climb up some other vertical object, like the palings of a fence, chicken wire, or tall grass stems, and metamorphose on them. "If it encountered a man lying down," writes Andrews, "it surmounted him and walked on over him to the tree, but if the man were standing up beneath the tree the cicada might climb up him and even transform fastened to his clothing, without reaching the tree" (p. 281). So what this species of cicada seeks is not "a tree", but some vertical object, standing out against the visual background, which it must climb. In natural and normal conditions this object is, generally, a tree, and for another purpose, that of oviposition, a tree is for the female the biologically suitable object. This is reached through very simple, but normally adequate, behaviour—behaviour adapted to a normal environment, which contains more trees than, for example, posts.

All the kinds of cicada insert their eggs in the tissues of plants, to the number of several hundreds, either in the twigs and branches of bushes and trees, or in the stems of herbs or grasses. They are not very specific in their choice, though the European *Tibicen plebeia* often selects the dry stems of the asphodel for oviposition. With respect to *M. septendecim*, Andrews tells us that they "commonly work upon twigs of about the thickness of a lead pencil and often of last year's growth. When they use smaller twigs this frequently works disaster as the twig breaks off and hangs with dead leaves or falls to the earth" (p. 287), and the eggs laid therein do not develop. Sometimes cicadas will lay eggs in quite unsuitable places; *Melampsalta cingulata* has been known to oviposit in an apple[8], *Tibicen erratica* in the boards of a shed roof, and on the handles of hoes left standing during the dinner hour. More remarkable still, *M. septendecim* has been seen trying to insert eggs in the iron rod of a bridge, extruding seven.

These scattered observations suggest that the instinct of the female when ready to lay is simply to climb upwards; normally this means climbing up a tree or a bush or a stem, and normally this action will lead her to a suitable site for oviposition. When she comes across man's handiwork her instinct to ascend does not lead her to a suitable spot—but she oviposits all the same. Instinctive behaviour is adapted to the normal or most usual situation to be encountered by the species, and takes no account of the unusual.

The cicadas do not lay their eggs in the ecological niche inhabited by the larvæ or nymphs, which, as we have seen, is underground in proximity to the roots of trees and other vegetation on which they feed. They lay their eggs, however, in places from which this habitat can be reached, by the simple device of falling to the ground and burying. The larvæ hatch out as tiny sheathed nymphs, the size of a flea, and climb out of the egg-nest towards the light, moving outwards or upwards to the ends of the twigs; then after a varying period of time, a quarter of an hour to several hours, they let themselves fall to the earth, where they immediately creep down any crevice or actually dig themselves in.

Snodgrass[9] gives the following description of the behaviour of newly hatched *Magicicada septendecim* which he placed in a pan of earth. "These at once proceeded to get below the surface. They did not dig in, but simply entered the first crevice that they met in running about. If the first happened to terminate abruptly, the nymph came out again and tried another. In a few minutes all had found satisfactory retreats and remained below. The avidity with which they dived into any opening that presented itself indicates that the call to earth is instinctive and imperative with them once their feet have touched the ground" (p. 408). Andrews[7] describes how the newly hatched nymphs of the same species squeeze themselves into crevices and cracks in the ground, fall down or climb down the holes left by their parents on emergence from their seventeen years sojourn below ground; he found that they could actually dig into the ground, slowly but surely.

Active burrowing has been observed also by Fabre and by Myers. Fabre's specimens (*Tibicen plebeia*) ran around for two hours before burying; when they were dug up they re-buried themselves immediately. Myers's young nymphs of *Melampsalta leptomera* placed on moist sand buried at once, twelve disappearing under the surface in ten minutes; after twenty-four hours some were three inches down.

Another example of oviposition in a place from which the newly hatched insect can, usually, reach its ecological niche is afforded by the dragonfly *Lestes viridis*, the larva of which is, like those of all dragonflies, aquatic. The female lays her eggs in the autumn on the underside of sallow or osier stems, forming galls. In the spring the larva hatches out, enveloped in its pro-nymph sheath. "By a strong bending of the body it jumps clear of the stem, and usually falls into the river. If, however, it falls on to the ground, it skips vigorously about, until, aided by the slope of the ground towards the river, it eventually jumps into the river"[10]. There it floats back downwards until it emerges from its sheath and takes up life on the bottom.

Deposition of eggs directly on the food plant or on other objects or substances suitable for the growth of the larvæ is of course a widespread phenomenon in insects. Here are a few examples.

In the Lepidoptera the female generally lays her eggs on the food plant or plants of the larva, and this is often found by its smell. The following examples I take from Hering's book[11].

The goat moth *Cossus ligniperda*, the caterpillars of which live in the woody tissues of willow and other trees, seeks out injured parts of the trunk on which to lay her eggs. The wound tissue being rich in nutritive substances forms a good spot for the larva to begin life, and from such spots it later burrows into the wood. Generally fermentation occurs at the wound, with production of acid and a characteristic smell. It is this smell that attracts the moth. One has been observed to settle down on a streak of vinegar on the tree trunk and attempt to find the wound in which to lay its eggs.

The butterfly *Papilio demoleus* normally oviposits on the orange-tree. It has been seen to lay eggs on various plants and on the ground to leeward of a strongly scented tree, these being so strongly impregnated by the smell as to be for the butterfly functionally equivalent to the parts of an orange-tree.

Females of the moth *Acronycta auricoma* kept in a box with their food plants were found to lay, not on the plants, but on the sides and bottom of the box, which was presumably impregnated with their smell. A similar state of affairs was found by Thompson and Parker[12] when studying host selection in the corn-borer *Pyrausta nubilalis*; females confined in cages with their food plant laid a considerable proportion of their eggs on the wood-work and the plant pots. These observations suggest that the chief valent characteristic of the food plant is its smell.

The fruit-fly *Drosophila ampelophila* lays its eggs in fermenting fruit, which it finds by smell. The experiments of Barrows[13] have shown that it exhibits an optimum response to a mixture of ethyl alcohol of 20 per cent and acetic acid of 5 per cent, which are about the strengths found in fermented apple juice.

A very interesting case has been described by Miss Ilse[14] from which it appears that the female cabbage white butterfly *Pieris brassicæ* may be guided in part by colour sense in finding the cabbage and other plants on which it lays its eggs. When hungry these butterflies give a specific feeding response to red, yellow, blue and violet colours such as occur in flowers; when they are set on egg-laying, however, they give a peculiar 'drumming reaction' with the first pair of legs, and this is elicited by any object which shows colours ranging between emerald green and greenish blue. During this phase yellow and pure blue colours are disregarded; the drive to egg-laying shifts attention to greens and greenish blues, characteristic of the leaves on which it normally oviposits.

A similar case was described by Knoll in 1922, whose observations are summarized by Bodenheimer[15] as follows: "The colours to which the hawk-moth *Macroglossa stellatarum* is attracted, change, in the gravid female, to that of chlorophyll, and this attraction, coupled with the smell of etheric oils of *Galium*, guarantees the proper oviposition and development of the caterpillars" (p. 48).

Regarding the choice of suitable hosts for their eggs by the parasitic Hymenoptera and Diptera a great deal of interesting work has been done, especially in the field of applied entomology. These insects lay their eggs in, or on, a great variety of Arthropod, chiefly insect, hosts, and their choice of a host may be highly specific, being limited to a particular stage—egg or caterpillar or pupa—of one species or of a narrow range of species. The Chalcid *Ooencyrtus kuvanae*, for example, limits her attacks principally to the eggs of the gypsy moth *Porthetria dispar*, though in the laboratory she will parasitize the eggs of eight other species of Lepidoptera[16]. Or the species may be 'polyphagous', attacking a wide range of hosts; *Compsilura concinnata*, a dipterous (Tachinid) parasite, injects its living larvæ into caterpillars of more than fifty species, including saw-fly 'caterpillars'.

But whether the choice is wide or restricted, the hosts chosen are in general such that the young can develop successfully in them; the choice is adaptive —and may be highly specialized.

That a parasite species in natural conditions rarely oviposits in a host unsuitable for its progeny has been conclusively shown by Thompson[17]. He has examined many thousands of hosts of all kinds, and has found that, with insignificant exceptions, they contained only parasites which are known to be capable of development in the hosts in which they occurred. The evidence indicates, he concludes, "that the choice of the host by the parasite is, in general, both *specific* and *adaptive*. The parasite is restricted to certain kinds of hosts; these kinds are, generally, the kinds suitable for the offspring" (p. 355). The instinctive activities of the parasitizing female are therefore, like most instinctive actions, both adapted and specialized. In normal and natural conditions the parasite will usually choose the right or biologically adequate host. In abnormal conditions, as when it is prevented from access to its normal hosts, it may oviposit in hosts or in objects which are unsuitable.

How does the insect, in natural conditions, find a certain kind or kinds of hosts? We cannot suppose that it knows by intellectual process that such and such hosts are suitable, and we have no reason to think that instinct is a magical faculty which gives the animal intuitive insight into the nature of things. It seems then, as I have indicated before, that the insect must be guided by perceptual clues, to which it is predisposed or pre-adapted to respond, and that these clues, or "sign posts", as Thompson calls them, are normally adequate to indicate the suitable object.

Summing up, we may provisionally conclude that each animal species has an innate predisposition to perceive, and act with reference to, particular objects and events, which alone have valence for it. It appears also that these objects and events are, in normal circumstances, biologically significant in relation to its special mode of living, of satisfying its needs and requirements, and of perpetuating its kind. We have clear indications too that in many cases the biologically suitable object, such as for example the right kind of host in which to oviposit, is distinguished in perception from others less suitable by means of a few valent characteristics, such as a specific smell, size or shape, often linked with one another. These are, for the animal, perceptual or sensory clues or signs, to which it is predisposed, or pre-adapted to attend, and they normally indicate, sufficiently well, the biologically suitable object. These signs are, therefore, *normally adequate*.

The possibilities of perception are of course limited by the animals' sensory equipment. What an animal *can* see depends upon the nature of its visual receptors; one does not expect fine visual perception from a frog or a mouse, or vision at all from an earthworm. The general character and scope of an animal's sensory and perceptual field is clearly determined by its sense organs; an orb-spider lives in a sensory world in which tactile and vibratory impressions are all-important, a bee in a world of specific scents, colours and shapes.

But the point of interest is not so much the sensory limitation and specialization of the possible perceptual field, but the fact that not all the potentially perceptible objects and events in the sensory field are valent, but only, as a rule, those that are biologically significant. Thus the honey-bee is specialized to attend instinctively to the scents of flowers, and cannot be trained to other scents, although its olfactory sense is highly developed; also it pays particular attention to images or figures that resemble or suggest flowers, and much less to images of unbroken contour (refs. in K. von Frisch[18])—it has an instinctive predisposition to seek out flower-shapes.

To many objects and events in its physical environment the animal remains behaviourally neutral; it does not notice them; they possess no valence for it. Only a few events will rouse it to attention and action. Here is an example. The slow-worm *Anguis fragilis* is, according to Wood-Jones and Porteus[19], singularly irresponsive to what goes on around it, "but let anyone who wishes to test its powers of vision . . . arrange that a little grey slug shall wander into the picture and note the instantaneous effect that this produces on the Blind Worm. The little grey slug is a biologically relevant stimulus, since in the ordinary way *Limax agrestis* forms the elected article of diet of *Anguis fragilis*." Now what the blind-worm perceives is not a slug, as we perceive and recognize it, but merely something of a particular size, shape and mode of motion, which has food-valence. We must carefully guard against the fallacy of assuming that animals perceive objects in the detailed and complex way that we do, as continuing 'things', recognizable by a large number of associated characteristics ; the evidence tends to show, on the contrary, that animals may attend to and perceive only one or few characters of objects. That is why their perception sometimes leads them astray.

Many of the so-called aberrations of instinctive behaviour are quite understandable when we realize these two things : (1) that the animal's sensory or perceptual field is often a very simple one, and (2) that *in normal conditions* the events and the objects possessing valence are *usually* objects and events that are biologically significant. 'Aberrations' occur when, in unusual circumstances or by exception, the valent characteristic or clue crops up as a character of a biologically unsuitable object. But the animal does not necessarily confuse the two different perceptual objects—the suitable and the unsuitable ; it may perceive only the valent characteristic which is common to both, and fail to perceive the differentia of the two. Within the limits of its instinctive perception, then, it does not err or make a mistake ; it is misled.

The fact that the sensory or perceptual field is usually a fairly simple one helps in some measure to reduce the mystery of instinctive behaviour ; we have no need to assume that an animal is attuned by heredity to recognize, without prior experience, a highly complex and specific object, such as it appears to us.

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STABILITY OF MINERALS IN SEDIMENTARY ROCKS*

BY PROF. P. G. H. BOSWELL, O.B.E., F.R.S.

AS the rocks which form the continental masses are disintegrated by the action of weathering and other geological agents, their detritus accumulates to form sedimentary rocks, ultimately on the sea-bed. In most instances, the constituents of these sedimentary rocks afford a clue to the character of the parent material and furnish information about the probable source and direction of transportation of the detritus (provided, of course, that the investigation is carried out over a sufficiently wide area). In the majority of sediments, especially the coarser types, the bulk of the grains consist, however, of the common mineral quartz, which yields little evidence of a particular source, for it is widely distributed throughout almost all types of rocks. It is able to survive many cycles of erosion because of its high resistance to chemical alteration and mechanical disintegration. But certain other constituents, usually of rarer occurrence, known as the heavy detrital minerals because of their higher density ($>2{\cdot}9$), are of much greater value as clues to origin, for many of them are characteristic of particular rock-types.

Of the many interesting problems that have arisen from the study of the occurrences of these minerals, that of the relative chemical stability of various detrital species is perhaps the most important and urgent at the present time. Deductions about the origin of sedimentary rocks, based on the varying proportions of constituent minerals, rest on the assumption that their present distribution either does not differ greatly from the original distribution (when the sediments were deposited) or has suffered changes which have affected all the minerals to a similar extent. In some cases, at least, such an assumption is unwarranted, for we have good reason to believe that the less stable species gradually decompose in the course of geological time. We find it necessary, therefore, to devise some means of assessing the extent of post-depositional changes in mineral assemblages. Obviously, we can call to our aid experimental work in the laboratory; and the results of such work have shown that minerals vary considerably in their resistance to attack by weak reagents like dilute mineral acids, humic acids, carbon dioxide saturated water and alkalis, although the effects, especially on detrital grains, have not yet been fully investigated. Natural conditions are difficult to imitate, for geological time is not available in the laboratory: we attempt to compensate for this by increasing the concentration of the reagents, but there are obvious objections to such a course. Nevertheless, we can reasonably hope to throw light on the natural processes by making the period of attack as lengthy as is humanly possible; also, we can try to simulate the field-conditions by adjusting the composition of the reagents to that of various ground-waters, and to imitate the resurgent action of their seasonal rise and fall.

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* Abridged from Part 2 of the presidential address to the Geological Society, March 1941.

Apart from experimental work of this kind, evidence bearing on the question of the post-depositional stability of detrital minerals can be obtained from field-studies. It is furnished by (*a*) the comparison of the varying incidence of mineral occurrences throughout the stratigraphical column, especially the comparison of Recent with older sediments, (*b*) the quantitative study of the various minerals of an assemblage from a particular formation throughout its lateral and vertical extent, and (*c*) the alteration-phenomena, especially as regards the form and surface features, exhibited by individual mineral grains.

Our experience of the considerable resistance usually offered by rock-forming minerals to solution and our familiarity with the ubiquitous occurrence of detrital minerals may lead us unconsciously to over-emphasize their durability. We may find it a useful corrective, therefore, to bear in mind the significance of two important factors, first, the almost unlimited draft on geological time that is available and, secondly, the relatively large surface area that is open to attack in the case of these minute grains. The work of several investigators, including Tamm, Stevens and Brammall, gives point to this latter consideration, for they found that most of the rock-forming minerals are hygroscopic when finely powdered, and are partially dissociated, the water then giving an alkaline reaction. The importance of these examples of hydrolysis at ordinary temperatures and pressures is manifest, for they suggest that, once such minerals are reduced by natural mechanical action to the size of the clay grade, their decomposition will probably be rapid; and, even in their coarser state, the grains are scarcely likely to escape corrosion under the action of ground-waters.

It is axiomatic to say that, other things being equal, the longer the time available for percolating water to act on minerals, the greater will be the amount of decomposition and the more complete the elimination of vulnerable constituents. Several investigators have directed attention to the fact that the relative abundance of certain minerals (such as andalusite, kyanite, the pyroxenes, the amphiboles, etc.) decreases with the increasing geological age of the sediments. Most striking, in this connexion, is the contrast between the mineral assemblages of the Recent or Pleistocene deposits and those of more ancient sediments. The former assemblages are rich in heavy constituents, both as regards variety and abundance, and the grains are often exceptionally beautiful. The number of species identified from an individual sand may be forty, sixty, or even more. In all, about a hundred and sixty rock-forming minerals have been found in sedimentary rocks, that is, practically as many as are known to occur in the parent crystalline rocks, if we exclude species of great rarity. But about forty of these, including the rarer species, can be found only in geologically youthful deposits. As they occur in ancient crystalline rocks, which have undergone erosion in the normal course of events in past epochs, their absence from the corresponding ancient sedimentary formations must be attributed to subsequent decomposition.

Passing to the consideration of the evidence furnished by the quantitative study of the occurrence of various minerals in a particular sediment, I may recall that, when the character of the mineral assemblage was used as a clue to the provenance of the detrital material, the progressive changes in relative abundance and size of grains of significant minerals, as the deposits were traced laterally, were interpreted as an indication of the relative distance from the source-rocks and thus of the probable direction in which they lay. This deduction followed from the assumption that, as the source became more and more distant, the less stable minerals were gradually eliminated in the reverse order of their resistance to abrasion, fracture and chemical decomposition. But any complacency we might have felt about the correctness of conclusions based on such evidence must have suffered a shock when R. Dana Russell published recently the results of his detailed researches on the lengthy transportation of minerals by the River Mississippi. Here we might have expected to get clear evidence of the gradual disappearance of the less stable elements. However, Russell found that the eliminatory effects appear to have been greatly over-estimated, at least with respect to the sand sizes.

The concept that even such 'weak' minerals as the pyroxenes, amphiboles and the felspars are unable to survive more than a few hundred miles of transportation because of abrasion during the journey is quite erroneous. Abrasion produces only minor changes in the mineral composition of Mississippi River sands in 1,100 miles of transport, and even these changes are largely offset by other factors, especially progressive sorting according to size. Similarly, chemical decomposition during transportation also plays but a minor part. The net result is that sands reaching the Gulf of Mexico have nearly the same composition as those at Cairo, Illinois. In order that the general applicability of his conclusions may be tested, Russell pleads for similar investigations of other river deposits, and of beach and dune sands ; we shall await these new results with great interest for, although it has been claimed that the gradual elimination alongshore of certain minerals has been established, the investigations have been less intense than Russell's and the area covered in each case was more restricted.

As the challenge thus thrown out must be met we may find it desirable also to re-investigate in at least the same detail those ancient sediments from which deductions have been made about the source of the material. Although, in certain instances, we may have erred on the side of boldness in framing our postulates, I am by no means convinced, after a fresh study of the European literature, that we have depended on them to such an extent that we have in consequence been led into serious error. In those cases where we have relied on the progressive diminution in size of significant detrital minerals, with or without reduction in variety of constituents (and such cases are numerous), and have taken due account of the grading of the sediment, we have doubtless gone but little astray. Also, for some time past, we have been less inclined to be dogmatic in our inferences about the source of detritus, based on records of mineral frequencies, largely because of our conviction that the potency of post-depositional processes should not be underestimated. In those instances where the grade of a sediment remains approximately uniform as the formation is traced laterally, the question of variation of frequency with grain-size obviously does not arise. The same is true if the grading varies, provided that all grades of the sediment have been subjected to mineral analysis. In either of these cases, a progressive change in the abundance of particular minerals may depend on one or both of two factors, distance of transportation and effects of post-depositional processes. Recent work (for example, that of F. Smithson, referred to below) bids fair to enable us to distinguish between the operation of these two factors.

It is a common experience that heavy minerals are often rare in coarse sands, other than natural concentrates, but are plentiful in less coarse sediments down to the clay grade, their distribution in the various grades being determined by their equivalent hydraulic value. As disintegration proceeds and the deposits become finer as a whole, the heavy minerals may be lost to sight because they have passed into the finest grades. The opportunities afforded for investigating all the grades of a present-day sediment are obviously much greater than in the case of a 'fossil' sediment, for portions of the latter have usually become inaccessible as a result of erosion or burial. Our conclusions must then be based on a part only of the deposit, but it has yet to be proved, from studies of Recent deposits, that they are thereby invalidated.

The survival of minerals after they have been incorporated in a sediment clearly depends on the ease or difficulty with which water can percolate through the deposit. Having regard to its slower passage through fine-grained rocks, we might expect such rocks to remain richer mineralogically, were it not that there is the offsetting tendency for clays, because of their mode of origin as the finest products of decomposition of other minerals, to be deficient in mineral variety. The conditions under which the differential effects of percolation are likely to be greatest are those where sands are protected by an impermeable cover. Not only should we then expect that a considerable proportion of the less resistant minerals would be retained in the sands, but also a vulnerable species (such as apatite, for example) would survive in quantity. Actual observations in Great Britain and the United States have shown this to be the case. The contrary state of affairs should be found in sands lying in a basin of clay, with the resurgent effect of ground-waters in full play.

By intensive study of the petrology of a specially chosen sediment, directed to a comparison of the relative abundance of particular minerals in relation to their 'pathology' and the grading of the sediment, light may be thrown on the efficacy of the post-depositional processes. The formation selected for study should preferably have a well-defined and fairly characteristic heavy mineral assemblage, and have been accumulated in such a way that all parts of its outcrop are approximately equidistant from its source-rocks. Even if these conditions are not exactly fulfilled, valuable results can be obtained from the investigation of a suitable sediment, as witnessed by F. Smithson's attack on just such a problem recently. Briefly stated, his method has been to study theoretically the variations in proportion shown by the heavy minerals as a result of sorting, of mineralogical changes such as decomposition and reconstitution, and of other processes. He has compared these results with the data obtained from the quantitative investigation of natural deposits. The similarities in the results, which are clearly demonstrated by graphical expression, seem too marked to be fortuitous. From his detailed studies of the Estuarine Series of the Jurassic of Yorkshire, he has been able to prepare maps showing changes in a number of mineral characters in 'contour' form.

Among the features thus represented in Smithson's work are the diminution in the richness of the mineral assemblages, in the percentage of samples containing garnet, in the estimated frequency of garnet and in the actual percentage of the mineral, as the middle of the Yorkshire basin is approached. The result of plotting the frequency of apatite is somewhat similar. On the other hand, the frequency of ilmenite + leucoxene, the frequency of authigenic pyramidal anatase and the percentage of zircon showing outgrowths (all secondary features and doubtless post-depositional) increase regularly towards the middle of the basin. Thus the pattern of the maps suggests that, along the tectonic axis (where the rocks are downfolded), there is an oval belt in which certain processes have been most active, leading to decomposition of garnet, the general impoverishment of the mineral assemblage, and certain secondary changes such as the production of outgrowths and new minerals. If all the mineral characters (including size and relative dimensions of grains) are treated statistically one by one and recorded on maps, an interesting result appears. Had the characteristics been preserved as they were when the sediments were laid down, all the maps should have presented, as it were, a picture of the palæo-geographical conditions prevailing at the time of deposition. Instead, we find that, owing to somewhat localized mineralogical changes, many of the maps present a generalized picture of the tectonics of the area, and in some, doubtless, both pictures are confused. If in some cases, then, impoverishment increases in proximity to the middle of structural basins rather than basins of deposition, we can understand how it was that the frequent coincidence of the two types of basins contributed to the widespread belief that progressive elimination of minerals increased with transport and afforded a clue to the distance and direction of the source.

Turning now to the third line of evidence, that furnished by the form of mineral grains, we recall that faceting, notching and fraying of detritals have frequently been recorded from many ancient sediments. These features have been imitated in the laboratory by Bramlette (who treated garnet with hydrofluoric acid) and Mackie (who subjected various minerals to the action of acid potassium sulphate). Although, as compared with natural processes like the attack by ground-waters, such treatment was drastic, its duration was very short. Naturally corroded grains are especially characteristic of certain stratigraphical horizons, presumably where the environment was exceptionally favourable. The type of corrosion, and therefore the form of the grains, differs according to the properties of the particular mineral, and the general composition of the sediment and the ground-water, although at present the relationship is far from obvious.

The angles, where measurable, of the notching or etching are peculiar to the particular mineral, and are related to the directions of crystal axes, optic axes, cleavage, or other determinable properties. Edelman and Doeglas, after investigating a large number of these corroded grains, are convinced that the features are closely related to the etch-figures of the minerals, where they are known, and are 'relict-structures' marking a stage in the process of gradual elimination of the minerals. The features are certainly post-depositional, for their delicacy and fragility are such that they could not possibly have withstood the rough-and-tumble of transportation.

As examples of British stratigraphical formations in which corroded grains are well developed, I may refer to the remarkable etching of garnet in the various sandy horizons of the Carboniferous system, the raggedness of the staurolite in many beds of the Permian and Triassic (in which the garnet is most frequently sub-angular or rounded), the frayed kyanite, saw-edged staurolite and lunate garnet of the Lias - Inferior Oolite sands, and the carious kyanite of the Northampton Ironstone. Numerous other examples could be cited to illustrate the selective character of the corrosion. Probably the phenomenon is related to the composition of the local ground-waters, and its manifestation depends on favourable conditions in the lithology and tectonic arrangement of the rock-succession, but until such relationships have been investigated in detail at particular localities, any discussion of the manner in which the post-depositional processes operate must be largely conjectural.

P.S. Since the above was written, a paper by M. N. Bramlette has appeared in the *Journal of Sedimentary Petrology* for April 1941 on "The Stability of Minerals in Sandstone", which contains many new observations and amplifies the above remarks in several important particulars.

OBITUARIES

Dr. Annie J. Cannon

ANNIE JUMP CANNON, who died on April 13, was born at Dover, Delaware, on December 11, 1863. While still a very little girl her curiosity was attracted towards the stars; and many evening hours were spent with her mother learning the constellations. When she left school, her father, despite the prejudice in those days against the university training of girls, sent her to Wellesley College where she graduated B.S. in 1884. Later she returned to Wellesley as a graduate student and studied physics under Prof. Sarah F. Whiting. After specializing in astronomy for two years at Radcliffe College she was appointed an assistant at the Harvard College Observatory under the inspiring directorship of E. C. Pickering. It was natural that here her interests should have become focused on variable stars and on the study of stellar spectra, the subject which was to become the great work of her life. In 1911 Miss Cannon was made curator of astronomical photographs at Harvard, and in 1938 was appointed William Cranch Bond astronomer, a post created in honour of the first director of the observatory. Though she officially retired from the staff of the Observatory in the summer of 1940, she continued with active work in her old department until a few weeks before her death.

Miss Cannon received many academic honours. Honorary degrees were conferred upon her by the University of Delaware, her own State; by the University of Groningen, Holland; by Wellesley, her Alma Mater; by Oxford, by which university she was the first woman to be honoured with a doctor's degree; by Oglethorpe University; and by Mount Holyoke College. In 1931 she was awarded the Draper Medal of the National Academy of Sciences, and in 1932 the Ellen Richards Prize. In 1914 she was elected an honorary member of the Royal Astronomical Society.

Although much the greater part of Miss Cannon's work consisted in the study of astronomical photographs and in the compilation of her own and other people's results, she was herself a very able observer. She made regular visual observations of variable stars, especially during the early years at Harvard; and many of the photographs used in her investigations were taken by herself. In 1922 she spent six months at the Harvard station at Arequipa, Peru, photographing the spectra of the southern stars with the 10-in. Metcalf telescope. Her work on variable stars alone was very prolific. She was one of the pioneers in the photographic study of stellar variability. She discovered 277 variable stars and 5 new stars, and published several extensive catalogues of variable stars. Perhaps her most important contribution to this branch of astronomy was her compilation of a bibliography of variable stars comprising more than half a million separate cards, which she always kept up to date, and which has been of immeasurable value to all workers in this field.

By far her most important work was the production of the "Henry Draper Catalogue", which in nine volumes of the *Harvard Annals* gives the spectral types and magnitudes of 225,300 stars completely over the whole sky down to about the ninth magnitude. Not only was Miss Cannon responsible for the examination and classification of the spectra and for the preparation of the material for publication, but it was mainly due to her that the system of classification adopted in the catalogue was developed and ultimately defined. The classification was first described by her in 1900, and again, with slight modifications, in 1912; most of the work of classifying the spectra was carried out between 1911 and 1915; the first volume of the catalogue was published in 1918; and the ninth and last volume was published in 1924. It was in 1922 that this same system of classification was adopted by the International Astronomical Union as the official system for the classification of stellar spectra. Since the publication of the main catalogue Miss Cannon had been working on its extension to fainter stars, down to about the 11th magnitude, in the Milky Way and other special regions. She was occupied with this work up to the time of her last illness; and already one volume of the "Extension" had been published.

Miss Cannon did much to further the study of science among women; and in 1933 she founded the Annie J. Cannon Prize to be awarded every few years to some outstanding woman astronomer. But there are other reasons why women of science are indebted to Miss Cannon; for through her lectures, through the example of her own work and enthusiasm, and through the help and encouragement which she so freely bestowed, she was an inspiration to all whom she came across.

Miss Cannon was not only one of the greatest of women astronomers, she was also a woman with a great personality and wide interests, yet withal she was one of the kindest, simplest and happiest of women. She had friends all the world over, among the highest and the humblest, among the oldest and the youngest; and when she was at home surrounded by her work she was never too busy to welcome them. In the death of Annie J. Cannon astronomy has lost one of its most valued workers and countless people a devoted friend.

R. L. WATERFIELD.

Prof. Edmond Leplae

NEWS has just reached Great Britain of the death of Prof. Edmond Leplae, professor of agriculture in the University of Louvain, and director-general at the Belgian Ministry for the Colonies, which took place at Louvain on February 2. He had been staying with his daughter and son-in-law in England not long before the War, but unfortunately returned to Belgium and, when the German invasion occurred, he and his wife fled to France, without being able to reach Great Britain; after the collapse of France they returned to Louvain. It was the second time he had been made homeless by the Germans, but in the War of 1914–18 he had been able to get to Britain and continue his work.

He studied at Louvain, and after making agricultural journeys in North Africa and Brazil, he returned there in 1901 to initiate a course in tropical agriculture. In 1910 the Belgian Government recognized the necessity for developing the agriculture of the Belgian Congo and appointed him director-general. He visited on a study mission the Dutch Indies and the British tropical Empire, and used the experience thus gained in organizing the agriculture of the Congo. It was necessary to provide schemes covering the needs of both Belgian colonists and native cultivators. One of the features which was being watched with interest was the introduction of certain compulsory crops into the native agriculture for the benefit of the native.

Prof. Leplae was one of the leading Continental authorities on tropical agriculture, and his papers issued by the Belgian Ministry include some of the best published on the Belgian Congo. He became favourably known in Great Britain as the result of a report of an agricultural journey in the Congo showing the marked progress that had been made since the Belgian Government had taken over the country in 1908. Native agriculture had been much developed by the extension of rice, oil palm, cotton, rubber and other crops, and although few Belgians had gone out as planters, the living conditions had been so improved as to make possible a considerable extension of plantation industry. A Botanic Garden and Experiment Station had been established at Eala on the equator, and there were other experimental farms in other parts of the country, among them, at Api, a station for the study and the rearing of elephants.

Prof. Leplae's special interests were the conservation of the soil and the development of livestock. He published several important papers on the latter subject and did pioneering work on the conditions necessary for the healthy growth of the animals. The best known is his long report "Organisation et exploitation d'un élevage au Congo Belge", the first edition of which was published in 1926 and the second in 1933; this dealt mainly with cattle; a later report dealt with sheep.

Others of his papers dealt with coffee and with quinine; he early realized the danger of allowing the Congo to become too dependent on the Dutch Indies and advocated a wider culture of cinchona in the Congo.

Leplae will long be remembered both for his contributions to scientific agriculture and for his charming personality. He was an ideal president of an international gathering; at one of the last of these before the War, the Congress of Tropical and Sub-Tropical Agriculture, held at Tripoli in March 1939, he presided with great distinction, and, in spite of the strained situation and the haunting fear at the back of everyone's mind, he carried the meeting through with complete success. He had a perfect command of English, and understood well and deeply sympathized with English ideals without abating in any way his profound affection for his own country.

E. J. RUSSELL.

Dr. R. P. Hobson

BY the death of Dr. R. P. Hobson at Bangor on April 12 at the early age of thirty-nine, agricultural science and biochemistry have lost a very able research worker. Dr. Hobson came to Bangor in 1934 to work on the sheep maggot problem in co-operation with the late Dr. Maldwyn Davies. His previous researches at Rothamsted and the London School of Tropical Medicine fitted him admirably for this work, funds for which were provided by the Agricultural Research Council. His publications dealing with this subject included ten studies (two in the Press) in the *Annals of Applied Biology*, and, in addition, contributions were made to the *Biochemical Journal*, NATURE and *Agriculture*.

The advances Hobson made in these studies are of fundamental importance, and his technique for attracting flies to oviposit on sheep, developed from a study of the chemotropism of the flies and the chemistry of the fleece, has been universally adopted. Workers in Australia, where sheep maggot research has proceeded for much longer and on a much bigger scale than in Great Britain, held Dr. Hobson's work in high esteem, and I know that they will regard their loss as being as great as ours. His more recent work on the effect of suint on sheep dips and the toxicity of calomel to blow-fly eggs is of far-reaching importance. Proposals for developing the ecological side of blow-fly investigations are being examined by the Agricultural Research Council. It was intended that this ecological work should run parallel with Dr. Hobson's researches, and his death at the present juncture is an incalculable loss.

Although not physically strong, Dr. Hobson's health improved after coming to Bangor, and his death after undergoing a major operation came as a great shock to all his friends. His colleagues at the School of Agriculture have suffered a grievous loss, and they offer their deepest sympathy to his widow, who is a member of the same staff. I. THOMAS.

WE regret to announce the following deaths:

Mr. John Crompton, O.B.E., former president of the Textile Institute, Manchester, on May 31, aged seventy-eight years.

Mr. R. L. Hobson, C.B., keeper until 1938 of the Department of Oriental Antiquities and of Ethnography in the British Museum, on June 5, aged sixty-eight.

Admiral Sir Frederick Learmonth, K.B.E., C.B., hydrographer of the Navy during 1919–24, on June 3, aged seventy-five.

NEWS AND VIEWS

The Manchester School of Pure Mathematics

THE Council of the London Mathematical Society has awarded the De Morgan Medal for 1941 to Prof. L. J. Mordell, professor of pure mathematics in the University of Manchester, in recognition of his many important contributions to the theory of numbers. The Adams Prize of the University of Cambridge has been awarded to Dr. H. Davenport, lecturer in mathematics in the University of Manchester, for two essays, (1) "On Waring's Problem", (2) "On the Geometry of Numbers". This double award is a very welcome and well-deserved recognition of the growing of the Manchester school of pure mathematics. Prof. Mordell has been the founder and leader of this school, and Dr. Davenport, formerly his pupil and now his colleague, is the most distinguished of its younger members. He has also attracted a considerable number of foreign mathematicians. His activities have always centred around the theory of numbers, and there is probably no other mathematical school which has contributed so much to the development of that theory during the last ten years.

Aircraft Research Appointments

SIR HENRY TIZARD, rector of the Imperial College of Science and Technology, has been appointed an additional member of the Air Council. In this capacity, and as a member of the Aircraft Supply Council, he will have special responsibility for studying and advising on scientific and technical policy.

Air Vice-Marshal F. J. Linnell, an Assistant Chief of the Air Staff, has been appointed a member of the Aircraft Supply Council in executive charge of research and development. He will be promoted to the acting rank of Air Marshal and will become an additional member of the Air Council on taking up this appointment.

The responsibilities of Sir Frank Smith as the executive head of the Department of the Ministry of Aircraft Production which deals with telecommunications equipment are unaffected by these appointments.

The R.A.F. Food Supplies

THE Air Ministry has appointed Dr. Thomas F. Macrae, a biochemist, and Squadron Leader W. P. Stamm, a specialist medical officer, to watch over the food supplied to the Royal Air Force to ensure that the greatest nutritional value is obtained. Dr. Macrae will investigate foodstuffs in use, and Squadron Leader Stamm will watch for the earliest signs of food deficiency in the health of the men. Both will study the preparation and cooking of food at the various units, the planning of a balanced ration from the available supplies, and the prevention of waste.

The Director-General of Man-Power

MR. G. H. INCE has been appointed by the Minister of Labour and National Service to fill a new post of director-general of man-power. Mr. Ince will take charge of the National Service, Labour Supply, and Military Recruiting Departments of the Ministry. Sir William Beveridge will relinquish the charge of the National Service and Military Recruiting Departments and will act as chairman of a committee, which will also include Sir Charles Craven and Mr. J. C. Little, to examine, in consultation with the three Service Departments, the employment of skilled men in the Forces.

Surgical and Hospital Spirit: Economy Necessary

FOR the good reason that the less the quantity of alcohol absorbed by uses for which alternatives can be substituted the more there will be available for the manufacture of munitions, the authorities are exploring the avenues by which economy in the employment of spirit can be effected. One of the channels through which extremely large quantities of alcohol flow in the course of a year is connected with surgical and hospital practice, and the attention of the Government departments concerned with the conservation of supplies of material is focused on this channel at the present time. It may well be that official instructions will be issued shortly to medical and hospital officers and nursing staffs of Service and other departments to exercise strict economy in the use of spirit for medical and surgical purposes as well as in nursing practice. Action will not stop at the Navy, Army and Air Force Services, for a strong appeal is likely to be made to surgeons and hospital staffs generally to use alcohol as sparingly as possible; it is probable also that recommendations will be issued by a body of recognized experts on the ways in which the use of alcohol may be avoided without prejudice to patients. The sterilization and storing of instruments, the habit common among surgeons of using alcohol for their hands before the gloves are put on, the use of tincture of iodine for the preparation of the patient's skin for operative incisions, the custom of swabbing spirit over the suture line when stitches are removed and the use of methylated spirit for preventing bed sores are the chief outlets of alcohol in surgical work and nursing methods.

There are alternative ways of producing the desired effects efficiently and they will probably be described in an authoritative memorandum. The use of dry heat is an appropriate substitute for spirit for the sterilization of the most important surgical instruments composed solely of steel or glass; if that method is not available, another effective means of sterilizing many types of instruments is by boiling them immediately before use. The risk of blunting the edges of surgical knives through boiling has been proved by recent experiments to be negligible. Where it is impracticable to boil instruments immediately prior to use, they may be stored in a dry state in a covered sterile receptacle instead of in spirit, or, alternatively, in a watery antiseptic solution to which a small amount of borax should be added to prevent rust. Such articles as hypodermic syringes and needles might still be stored in spirit since only a small quantity is needed. If alcohol is used in drying the hands of surgeons it could be applied economically, but adequately, by the use of a spray after the hands have been thoroughly washed and dried with a small sterile towel. Instead of using tincture of iodine for the patient's skin before operation, the area of the operation could be painted with a watery solution of iodine or of one or other of the antiseptic dyes. For swabbing the suture line when stitches are removed after a clean operation, the application of sulphanilamide powder can be recommended in suitable cases, or failing that an antiseptic soap may be used. For treating the backs of bedridden patients an effective method is light massage with zinc oxide and castor oil after the skin has been washed and thoroughly dried; in a small number of clinical conditions, however, the use of spirit for this purpose would be still desirable. More complete instructions will be given, no doubt, when the recommendations are issued.

Electronic Engineering

DURING the past quarter of a century, a prodigious advance has taken place in the development and application of devices utilizing free electrons, either alone or in association with positive ions, including the wide variety of radio valves, gas-filled rectifiers and cathode ray tubes, as used nowadays in communication and electrical engineering. Technical progress in this subject has hitherto been recorded as an important and ever-growing side-line in journals otherwise devoted mainly to radio communication and television, or to electrical engineering in general. As from the June issue, the Hulton Press, Ltd., has incorporated its previous monthly publication entitled *Electronics, Television and Short-Wave World* in a new periodical named *Electronic Engineering*, which is to be of such a scope as to cover the whole field of research and application of electronic devices in general.

The new journal will provide all those engaged in research and industry in this subject with a medium for interchanging ideas and learning the progress which is being made in all parts of the world. Original articles by specialists will appear regularly, and special features will include patent abstracts, reviews of books and instruments and novel circuit arrangements. An important feature, which may be expected to contribute notably to the success of the new periodical, is that Mr. G. Parr, who has been appointed editor, has been closely associated with the electrical and radio industry for more than twenty years. He is the author of a book on the cathode ray tube, and has played an important part in demonstrating the versatility of these tubes as recording and measuring instruments for laboratory and other purposes. The June issue of the journal contains the first of a series of data sheets for the use of design engineers, as well as articles on amplifiers, oscillation generators, quartz crystals and other audio- and radio-frequency problems of current interest.

Cancer and Occupation in Denmark

IN a paper on this subject read before the Danish Medical Society on November 5, 1940 (*Nordisk Med.*, **9**, 869; 1941), Dr. Johannes Clemmesen, of Copenhagen, maintains that cancer research has lost contact with practical medicine and that the etiology of the disease is almost exclusively studied in laboratories, while clinical mass observations are far too uncommon. The following results were obtained by him on examination of the mortality from cancer among males in various occupations in Denmark during the period 1935–1939. In agriculture and similar occupations deaths from cancer in the age-group 45–64 were fewer than would be expected from the average of cancer deaths among the population as a whole. In industry the cancer mortality was higher than the average in accordance with the higher mortality from all causes for this group. After the sixty-fifth year the cancer mortality was the same for all occupations, but the localization varied in the different occupational groups. The cancer mortality among males and females in Denmark showed the following characteristics. In the age-groups 25–44 and 45–64 it was highest among females. In the older age-groups it was highest among males, but this excess for males was highest in Copenhagen, less in the provincial towns and not definite in the rural areas. The total cancer mortality was also highest in the capital, probably owing to the lower mortality from that cause in the agricultural than in the industrial group.

Excavation of Growing Trees with Earth

FOR purely horticultural purposes it is often required to remove trees and shrubs with a ball of earth for transference elsewhere, and considerable care and ingenuity must be exercised if success is to be achieved. Mr. F. A. F. Schmid and Mr. F. J. Nutman, of the East African Agricultural Research Station, Amani, Tanganyika Territory, have described (*Soil Science*, **49**, No. 6; June 1940) a method devised by them during research on the water relations of coffee, for which they required large plants several years in age which could only be obtained in the field. The authors state that by their method a growing tree together with about two tons of soil has been successfully transplanted, and that only the outbreak of war has prevented further excavations. There appears, it is said, to be no limit to the size of the soil block that can be isolated in this fashion save only the size of the vehicle available for transport.

Their work was done in a district with a very light, friable, volcanic ash soil, with few stones. It is admitted that the presence of stones might make this method difficult if not impossible. The apparatus required is simple. The method consists of the preparation, by mechanical means, of an accurately cone-shaped pillar of soil, of a known and definite angle, of the fitting to this pillar of a metal container designed to have the same angle, and of the undercutting and removal of the soil block. Since the container fits the block exactly, and since the lift is *via* the sides, the authors state, of the cone-shaped receptacle, no soil disturbance is possible. The paper, with diagrams, explains the method in full.

Hygiene of the Garden

D. E. GREEN has seized the opportunity of war-time need to survey those plant diseases which are transmitted or aggravated by lack of hygiene in the garden (*J. Roy. Hort. Soc.*, **66**, Parts 1–5, Jan.–May, 1941). This series of papers focuses attention upon the simplest and most economical methods of combating plant maladies, namely, by removing sources of infection and contributory causes. Incomplete removal of diseased material from previously infected crops, the presence of uncontrolled rubbish heaps, the use of contaminated soil for composts, sowing disease-bearing seed, unskilful watering, unbalanced manuring, and even undue handling of the plants by the gardener are all potent factors in the relative incidence of parasitic fungi. The list of diseases which are subject to hygienic control is an impressive one, and includes club root, several root-rots, footrots and damping-off, many virus diseases, leaf spots and rusts; in fact, all diseases should in some measure be subject to this form of control. Mr. Green describes numerous maladies with the help of excellent photographs, and it is difficult to escape the conclusion that phytopathologists and gardeners should direct far more attention to this efficient but unspectacular method of raising healthy plants.

The British Ecological Society

REFERRING to the note in NATURE of May 31, p. 669, on his award of the Linnean Gold Medal, Prof. A. G. Tansley writes: "In the notice of my work which appeared in NATURE of May 31 there is a small error which should, I think, be corrected. It is stated that in 1917 I took over 'the secretary's work and editorship of the Society's *Journal*'. It was not I, but Dr. (now Prof.) E. J. Salisbury, who became secretary of the British Ecological Society in the autumn of 1916, and he held the post until 1932. The guidance of the Society through the critical years of its development was thus shared by the two of us."

The Ray Society

THE annual general meeting of the Ray Society having been omitted for the current year, with the consent of the members, the present officers and council will remain in office, with the exceptions that Dr. E. S. Russell, president of the Linnean Society, has been co-opted as a vice-president and Dr. Stanley Kemp as a member of council. In the annual report, which has just been circulated, the Council states that the accounts show a much more satisfactory state of affairs than might have been anticipated under war conditions. The second volume of Dr. Bristowe's work "The Comity of Spiders" is nearly ready for publication. A volume on "The Larvæ of Decapod Crustacea" by Dr. Robert Gurney is in the printers' hands and will form the issue to subscribers for 1941. The Council will be glad to consider suitable works for early publication. Authors are requested to communicate with the secretary of the Society. The official address of the Society remains "c/o The British Museum (Natural History), Cromwell Road, London, S.W.7", but personal communications for the Secretary should be addressed to Dr. W. T. Calman, "Willowbrae", Tayport, Fife.

Automatic Equipment in Trunk Telephone Working

UNTIL a few years ago, practically all trunk telephone working was done on a delay basis. The principle involved an extravagant method of operating, namely, the segregation of trunk mains into small groups, each of which was controlled by a telephonist. In the Engineering Supplement to the *Siemens Magazine* of March, Mr. H. E. Humphries gives an instructive discussion of the whole subject, laying stress on automatic equipment as an aid to trunk switching. With such an aid, a telephonist can occupy her time fully with other switching duties during a waiting period, and need concern herself with a waiting call only after receiving a signal that a free trunk is available. Remotely controlled automatic switches provide the telephonist with access to a multitude of all trunks. An analysing device in the automatic unit automatically determines which course should be followed. The telephonist leaves the circuit in this waiting condition and proceeds with other work, the supervisory lamp on the trunk side of the connexion giving a fleeting signal every six seconds to remind her that there is a call awaiting completion.

An automatic trunk exchange initially costs more than its manual counterpart, and the natural question arising is whether or not the additional expense of automatic working is a sound investment. Mr. Humphries states that the normal busy-hour load on the Capetown Trunk Exchange demand suite is approximately thirty-six calls per position. This figure is appreciably higher than any equivalent operating procedure could produce on a manual system. Another way of viewing the matter is that an automatic system, with its increased facilities, gives a better and faster service, which is the first necessary step of any administration towards active development of its trunk system.

Meteor Observations in India during 1940

MOHD. A. R. KHAN, of Begumpet, Deccan, who has communicated the results of his observations of meteors for several years to NATURE, has sent an account of his observations during 1940. From this it appears that during the year a total watch of 103¼ hours was maintained on 152 nights and the paths of 1,390 meteors were recorded. The great majority of these belonged to the sporadic class—a result in agreement with that obtained by the Harvard Expedition to Arizona in 1931. The month of December was most prolific, yielding a total of 472 meteors, and on some nights the hourly rate was about forty. An analysis of the magnitudes of the meteors observed is interesting and the table given below will show the relative paucity of very bright meteors. Eight were so faint that no definite magnitude could be assigned to them, and 117 had magnitudes between 4·5 and 5·5. The others were classified as follows:

No.	Mag.	No.	Mag.	No.	Mag.	No.	Mag.
207	4	208	2·5	5	−2·5	6	−4
182	3·5	190	2	6	−3	3	−5
188	3	268	1·5 to −2	1	−3·5	1	−7

Of the bright meteors, 17 were observed after midnight and 5 before midnight, the meteor of mag. −7 being included in the former class. It was observed on March 22d. 15h. 42m. U.T. and gave off a number of sparks during its flight. It is suggested that some of the debris may have fallen to the earth. The usual shower meteors were badly represented, only thirty-six being recorded. Some very bright meteors had low apparent speeds and one in particular is worth mentioning. On Oct. 19 a reddish meteor, mag. 0, took half-a-minute to cover its track of 25°. Another interesting point is that, while meteors of 2·5 to 3 mag. occasionally gave persisting streaks, brighter meteors failed to do so in many cases even when they were appearing to move swiftly. It is suggested that streaks are produced only in certain definite regions of the atmosphere if the meteor has a high geocentric velocity.

Seismological Data from Australia

Valuable data concerning earthquakes during the period October–December 1940 have just been received from the Riverview College Observatory, New South Wales (director, D. J. K. O'Connell, S.J.). During this period sixty-three earthquakes were registered and interpreted, eleven giving a maximum amplitude greater than 2 mm. The greatest amplitudes were on November 27, 1940, when an amplitude of 7·3 mm. was recorded by the north–south component seismograph and 9·0 mm. by the east–west component. This earthquake was felt at Neinduk, at North Baining with intensity 6 on the Rossi-Forel scale, at Kavieng *R.F.* 5 and at Rabaul *R.F.* 4–5. The earthquake of November 22, 1940, which only gave a maximum amplitude of 0·5 mm. at Riverview was felt at Rabaul, New Britain *R.F.* 4, Neinduk *R.F.* 3, Pondo *R.F.* 5 and Kuridui *R.F.* 4. Microseisms prevented the interpretation of some seismograms on which the earthquakes only recorded with small amplitude.

Antonio Pacinotti (1841–1912)

On June 17 occurs the centenary of the birth of the Italian physicist Antonio Pacinotti, who contributed to the early development of the dynamo. Born at Pisa, where his father, Luigi Pacinotti, held the chair of physics, he worked in the physical laboratory of the University, and it was while a youth of eighteen serving in the Garibaldean wars that he pondered over electromagnetic problems. At the age of nineteen he devised an electric generator with a ring armature which he described in *Il Nuovo Ciminto* of May 3, 1865. Though, unlike his contemporaries Jedlik and Hjorth, he did not conceive the possibility of self-excitation, his machine had outstanding results. When twenty-one Pacinotti became assistant astronomer at Florence and afterwards held professorships of physics at Bologna (1864), Cagliari (1873) and Pisa (1882), to which place he returned on his father's death. His achievements were recognized in many ways, and in 1902 the Institution of Electrical Engineers elected him an honorary member. He died at Pisa on March 25, 1912. The seventy-fifth anniversary of his invention was commemorated at Pisa in 1934. A life of Pacinotti has been written by Prof. Polvani, of the University of Milan.

Raymond Vieussens

This year marks the tercentenary of the birth of the celebrated French anatomist Raymond Vieussens; the exact date of his birth is not ascertainable. He was born at a village of the same name in Rouergue, the son of a lieutenant-colonel. He received his medical education at Montpellier, and at the age of thirty became physician to the Hospital of St. Eloys. During the first ten years of his service there he performed five hundred autopsies not only to find out the cause of death but also to discover the normal structure of the brain and spinal cord and follow the nerves from these organs to their insertions. In 1684 he published the results of his investigations in a work entitled "Neurographia Universalis", which contained the most complete description of the brain and spinal cord hitherto given and won him a great reputation throughout Europe. He was elected fellow of the Royal Society in 1688 and a member of the Royal Academy of Sciences in Paris.

In 1685, shortly after being summoned to Paris by Louis XIV to attend the Marquis de Wardes, Vieussens was appointed physician to Madame de Montpensier, cousin to the king, and held that office until her death in 1693 when he returned to Montpellier. In 1705 he published his "Novum vasorum corporis humani systema" which contained a record of several interesting autopsies. In 1715, the year of his death, he brought out a "Traité nouveau de la structure et des causes du mouvement naturel du cœur", which is remarkable for a description of mitral stenosis and of the pulse of aortic incompetence. In addition to his works on the nervous and cardiovascular systems he was the author of an important work on the structure of the ear (1714). He also discovered the fermentative effect of the saliva and the presence of an acid in the blood. Vieussens's name was formerly attached to a number of anatomical structures, but was omitted in the Basle nomenclature introduced in 1895, so that it is no longer familiar to the rising medical generation.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

Chlorazol Black *E* as a Vital Dye

THE use of chlorazol black *E* as a stain for general purposes in ordinary microscopical technique was suggested by Prof. H. Graham Cannon in NATURE some years ago[1]. This nearly black substance agrees with many vital dyes in being a sulphonated acid azo-compound; but whereas trypan blue, trypan red, vital new red, diamine fast scarlet, benzopurpurine 4*B*, the various Niagara blues, new Bordeaux *L*, Congo rubine, afridol blue, Baumwoll-rubin, etc., all possess two azo-linkages, chlorazol black *E* has three. It was thought interesting to try the trisazo compound as a vital dye, and the results suggest that it may be a useful one.

A 1 per cent suspension of chlorazol black *E* (No. 581 in the Colour Index) in distilled water may be sterilized by bringing to near boiling-point, cooled, and injected subcutaneously into mice in doses of 1 c.c. Injections may be made every day or nearly every day for a week, and the animal killed the day after the last injection. The dye will have spread locally under the skin and coloured it in the vicinity of the injections, but there will not be that general staining of the skin of the whole of the body which occurs with trypan blue and other disazo dyes. Some slight discoloration of the muzzle may be noticed. The internal organs will be found almost to have retained their ordinary colours. If various organs are fixed in Zenker's fluid, embedded in paraffin and sectioned, it will be seen, however, that the dye has been circulating in the blood; for the elements of the reticulo-endothelial system will have taken it up strongly. Striking preparations may be made by staining chromatin with safranine and cytoplasm with orange *G*, against which combination the black particles of the dye show up sharply. The Kupffer cells in the liver will be found to have their cytoplasm loaded with the dye, while the liver cells themselves are free from any particle of it. No trace can be found in any of the kidney cells and the urine is of the ordinary colour; so the dye is apparently not excreted and one can therefore load the reticulo-endothelial system to capacity. Sections of the subcutaneous tissue in the vicinity of the injections show that the histiocytes and fibrocytes have taken up the dye in large quantities.

The difference between the trisazo and disazo compounds in relation to vital staining cannot be attributed simply to the relative sizes of the molecules, for the disazo compound trypan blue has a molecular weight (961) that is actually considerably greater than that of the trisazo chlorazol black (782). One must suppose that particle size rather than molecular weight is concerned, in accordance with the recent findings of Gordon and Chambers[2] on the penetration of acid dyes into cells.

Chlorazol black seems to combine the selectivity of such vital dyes as isamine blue with the rapidity of action of the disazo compounds, and may therefore merit trial by other workers. The specimen used was from batch number 244541 of the British Drug Houses, Ltd. Dr. H. M. Carleton has kindly examined my slides and given me the benefit of his comments on them.

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[1] Cannon, H. Graham, NATURE, 139, 549 (1937).

[2] Gordon, H. K., and Chambers, R., *J. Cell and Comp. Physiol.*, 17, 97 (1941).

Parathyroid Glands and Lactation in the Rat

REMOVAL of the thyroid gland together with the associated parathyroid tissue was reported by Nelson and Tobin[1] to have no deleterious effect on lactation, as measured by the growth-rates of litters, in the rat. Contrary results were, however, reported by Folley[2] who, moroever, failed to improve lactation in thyroidectomized rats by injections of thyroxine and small doses of parathyroid extract. Nelson[3] has since confirmed the original findings of Nelson and Tobin. A re-examination of the question in this laboratory, partly in collaboration with Miss H. M. Scott Watson, has reaffirmed the almost total failure of thyroidectomized rats to rear their young and has also shown that administration of much higher doses of parathyroid extract than were previously used results in a significant improvement in lactational performance, which however is still below normal. Typical results are shown in the accompanying table.

Group	No. of rats	No. of pups at 6th day of lactation	No. of pups at 21st day of lactation (weaning)	Mean wt. of pups at 21st day of lactation (gm.)
A	5	38	5	17·4
B	4	30	27	25·6

Group *A*: rats thyroidectomized on 6th day of lactation.

Group *B*: rats thyroidectomized on 6th day of lactation and given daily subcutaneous injections of 10 units of Para-thormone (Lilly) from days 6–9 inclusive and 20 units from days 10–20 inclusive in two cases and from days 10–16 inclusive in the two remaining cases.

These results indicate that the suppression of lactation following removal of the thyroid gland and associated parathyroids is partly due to parathyroid deficiency, a result not altogether surprising in view of the large drainage of calcium from the body during lactation. It must therefore be concluded that the integrity of the parathyroid glands is essential for normal lactation. These experiments are continuing and will be fully reported elsewhere.

I am indebted to Dr. S. K. Kon for generous facilities for working with rats and to Messrs. Eli, Lilly and Co., Ltd., for part of the 'Para-thor-mone' used.

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May 17.

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[1] Nelson, W. O., and Tobin, C. E., *Endocrinology*, 21, 670 (1937

[2] Folley, S. J., *J. Physiol.*, 93. 401 (1938).

[3] Nelson, W. O., *Amer. J. Physiol.*, 126, P. 592 (1939).

Glycolysis, Hydrolysis and Phosphorolysis in *Corynebacterium diphtheriæ*

THE two culturally distinct types of *Corynebacterium diphtheriæ—gravis* and *mitis*—differ biochemically in that only the former glycolyses glycogen although both glycolyse simpler carbohydrates such as glucose and maltose. On examining the hydrolysing capacity of these bacterial types *in vitro* we found that both gravis and mitis yield cell-free extracts or autolysates which convert glycogen into fermentable reducing sugar. In view of the differential desmolytic behaviour of the living cells towards glycogen it is necessary to conclude that in glycolysis the glycogenase of living cells does not necessarily come into play. It seems probable rather that gravis achieves the degradation of polysaccharide into lactic acid through a reaction path in which hydrolysis takes no part.

The only difference in enzymic outfit between gravis and mitis *in vitro* so far observed by us, is that whereas extracts of gravis contain an active phosphatase, this enzyme is absent in extracts of mitis. It seems natural to connect the difference in glycolytic behaviour with the noted difference in the phosphorylation-dephosphorylation apparatus. Our findings support the theory[1] that the desmolytic degradation of complex carbohydrates *in vivo* by muscle, yeast and bacteria may proceed not through hydrolysis but by a direct attack on the saccharide molecule through phosphorolysis (2–5).

A detailed account of this investigation will be given elsewhere.

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April 10.

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[1] Leibowitz and Hestrin, *Enzymolog.*, **6**, 15 (1939); NATURE, **145**, 671 (1940); further papers in the press.

[2] Cori and Cori, *Proc. Soc. Exp. Biol.*, **39**, 337 (1938).

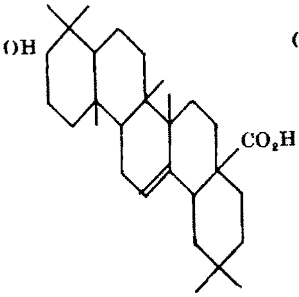
[3] Schaeffner, *Naturwiss.*, **27**, 195 (1939).

[4] Kiessling, *Biochem. Z.*, **302**, 50 (1939).

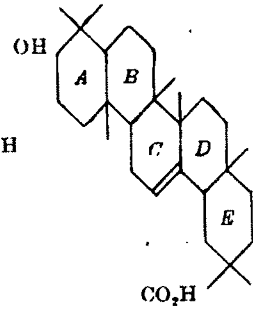
[5] Hanes, NATURE, **145**, 348 (1940); *Proc. Roy. Soc.*, B, **128**, 421 (1940).

Position of the Carboxyl Group in Oleanolic and Related Acids

MEASUREMENTS recently carried out on monomolecular films of β- and γ-oleananic acids and esters[1] show that these compounds occupy areas very much smaller than those which are calculated on the basis of Haworth's triterpene formula (I), the limiting values for the two acids being 52 and 45 sq. A. respectively. In these two compounds there are no water-attracting groups, apart from the carboxyl group, which could be responsible for the effects observed, as in oleanolic acid itself[2]; the results suggest that the carboxyl group must occupy a position in one of the terminal rings. Of the possible formulations, the structure (II) for oleanolic acid satisfies the principal requirements.



(I)



(II)

The ready formation of lactones from oleanolic and related acids appeared at first to present a difficulty, but examination of models shows that lactonization should be possible with certain stereochemical arrangements of rings *C*, *D* and *E*, and a *cis* or a *trans* fusion of the last two rings. A *cis* fusion of rings *D* and *E* has already been suggested to account for certain reactions of quillaic acid[3].

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[1] Jacobs and Fleck, *J. Biol. Chem.*, **96**, 341 (1932).

[2] Askew, *J. Chem. Soc.*, 1585 (1936).

[3] Bilham and Kon, *J. Chem. Soc.*, 1469 (1940).

Effect of Caffeine and Bromide on Dark Adaptation

DURING the past two years we have been making an investigation of dark adaptation of the central region of the retina with special reference to the recovery occurring during the first minute after the end of light adaptation. The work has included some experiments on the effect of doses of potassium bromide and of caffeine on the subject. With doses of potassium bromide up to 25 grains no effect on the rate of adaptation or on the scatter of the observations was observed. With one subject who was used to drinking strong coffee and tea frequently no effect was produced with a dose of 8 grains of caffeine. With another subject whose consumption of tea and coffee may be regarded as at least average, a definite, though rather small, increase in the rate of adaptation was noted when doses of caffeine of up to ten grains were given. The increase was appreciable with 6 grains. In view of these results it is not surprising that at no time were we able to observe any effect due to fatigue or to minor ill-health.

It should perhaps be stated that the effect of a comparatively short period (17 days) of vitamin A starvation was considerably larger than any of the effects observed with the caffeine. The subject returned to nearly the original rate of adaptation as the result of a single large dose of vitamin A (24,000 I.U.).

These results in so far as they refer to fatigue are in agreement with those recently published by Semeonoff[1]. The rather small effects obtained with caffeine may be compared with experiments[2] which appear to show that taking alcohol raises the vitamin A content of the blood considerably.

We wish to express our thanks to the Medical

Research Council of Ireland for a grant in support of this work, and also to Prof. D. S. Torrens for helpful advice.

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May 15.

[1] NATURE, 147, 474 (1941).

[2] *Science*, 93, 21 (1941).

Infestation of Manufactured Food by Insects

IN summarizing the "Report on a Survey of the Infestation of Grain by Insects"[1], Dr. A. D. Imms[2] has stated that the important result of the survey is the demonstration that the infestation occurs throughout all the industries. In Dr. Imms's opinion the major problems appear to be the regulation of humidity and temperature.

Another side of the problem which is no less important and which has not been dealt with by the Committee is the presence of infestation in manufactured cereal products which are exported from Great Britain to the tropics. It was brought to our notice that a large number of bottles in different consignments of a proprietary invalid food manufactured in England had become infested with beetles.

The food was prepared from malted cereals and wheat flour and the process of preparation was a complicated one in which the article was subjected to heat not exceeding 170° F. and was also subjected to drying *in vacuo*. On examination, the seals of the bottles were apparently intact, although beetles, a large number of them being dead, were noticed inside the bottles. They were two distinct species, *Tribolium castaneum* Linn. and *Sylvanus surinamensis* Linn. The solidification of the food was an inevitable consequence of infestation and in a few samples solidification occurred without the presence of beetles.

With special regard for the manufacturers, we made some experiments with the view of determining if possible how these beetles invade the food. The two main propositions were: (1) if they enter the food in the egg or larval stages before this is put into the bottles; (2) or if they get in afterwards. The former presumption is groundless as a temperature of 125° F. over a period of one hour has been found fatal to eggs, larvæ, pupæ and adults. That it is more probable that the infestation takes place after bottling is supported by the statement made by the local representative that an absolutely fresh consignment is very rarely infested.

It is therefore quite apparent that the beetles get in through the sealing and this is supported by the fact that sometimes the food has been found to solidify without the apparent presence of beetles, which suggests that in these cases there has been connexion with the outside air. In one bottle in which we carefully examined the attachment of the circular disk and waxed paper with a hand-lens, we found the cover loose in two places. This, however, may not have represented careless packing, but the work of the beetles or their larvæ. We therefore suggested the possibility of the beetles, whether larvæ or adults, making a way for themselves through the sealing. With this possibility in view we set up an experiment to see whether larvæ and adults which were previously starved could invade a bottle of the food through a well-sealed cover and we found that they could not or did not. When placed inside a sealed bag made of thin paper without any food, which was then buried in flour dust, the larvæ and adults were not able to eat their way out and died of starvation inside the bag.

The weight of evidence therefore inclines us to the belief that the insect gains ingress to the food through crannies left in the sealing of the covers and not by gnawing a way through for itself.

Regarding the country of origin of infestation, both the species being cosmopolitan, there is no reason why invasion of the food should not take place anywhere either in England, on the sea, or in India. However, as larval and pupal skins were detected in the solidified material and especially on the inside of the waxed paper used for sealing, it is highly probable that the invasion takes place in the larval stage. The smallness of its size and its flattish form allows it to penetrate apparently tightly wrapped packages.

It is indeed surprising that the beetles showed no signs of any attempt to multiply, although both sexes were present. In temperate climates there are normally 4–5 generations a year, but in the tropics the breeding of both the species is continuous.

The matter of using the proper kind of seal is therefore extremely important and sealing wax should be preferred to ordinary wax, the attachment of which is likely to be loose due to shaking on the journey.

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[1] "Report on a Survey of the Infestation of Grain by Insects." (London: H.M. Stationery Office, 1940.)

[2] "Grain Destruction by Insects", by Dr. A. D. Imms, NATURE, 146, 238 (1940).

"The Physical Condition of the Planets"

READING Sir James Jeans's most interesting and informative lecture at the Royal Institution (see NATURE, May 3, p. 526), one is, I think, brought up short by the following statement "The greater part of both atmospheres [of Jupiter and Saturn] will be at a pressure of more than a million terrestrial atmospheres. Under such pressures, no known substance remains gaseous." This latter statement is so far contrary to what I, in common no doubt with most chemists, have been taught "from my youth up", that I cannot believe it represents Sir James's considered opinion.

If Sir James Jeans really thinks that the general acceptance for the past fifty years of the 'critical temperature' as a definite property of all gases is erroneous, and that the observations of Andrews and of Amagat have been incorrectly interpreted, surely he would have taken some other opportunity than a semi-popular lecture to announce his conclusion to the scientific world.

Another point in Sir James's lecture which appears difficult of acceptance is the postulation of low temperatures in the interiors of these large planets. It is, I think, generally accepted that in a planetary atmosphere in which convection occurs, of which there is ample observational evidence in these cases; the temperature will rise in the layers of increasing pressure in accordance with the known laws of adiabatic compression.

Sir James quotes the observed temperature of the visible cloud surface of Jupiter as −138° C. or 135° K. Published estimates of the ammonia content of the atmosphere above this layer suggest a somewhat higher temperature, as the vapour pressure of ammonia falls to very low values about 145° K.

Assuming the pressure at this level to be one terrestrial atmosphere (it is likely to be much lower) and that the ratio of the specific heats of the gases concerned is only 1·33, the temperature of the part of Jupiter's atmosphere which has a pressure of a million terrestrial atmospheres would be 13,000° K., a temperature probably above the critical temperature of all substances. As a large part of Jupiter's atmosphere presumably consists of helium and the ratio of the specific heats of more complex gases rises quite rapidly with increasing pressure, the average value of this ratio is probably greater than 1·33, in which case the high temperature quoted will be reached at a lower pressure.

The observations of the low temperature of Jupiter's visible surface show that there is no perceptible loss of heat by radiation from matter at high temperatures, so the whole of the mass of the planet within a layer, say, 6,000 miles below the visible surface must be at a temperature of tens of thousands of degrees absolute. If this conclusion is correct, it would make the explanation of the low average density of the larger planets much easier.

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I HAD not meant to express any special views about critical temperature. It is true that the atmospheres of Jupiter and Saturn are above the critical temperatures of some substances, but I imagine critical temperatures become completely unimportant when the pressure is 10,000 or more times the critical pressure; the a/v^2 of Van der Waals becomes insignificant compared with the p, so that the equation of state reduces to $p(v-b)=\alpha T$. Consequently I should expect all substances to behave similarly, whatever their ordinary critical temperatures may be, and in a way which will certainly be very different from that of the usual gas.

In this part of my lecture I was not expressing my own opinions, but describing the conclusions reached (admittedly rather speculatively) by Wildt and H. Jeffreys. These conclusions are based, among other things, on the extent to which Jupiter and Saturn are flattened by their rotation. As I explained in the spoken lecture, this tells us something as to the internal distribution of mass in these planets, although not enough, I think, to rule out Mr. Phelps's suggestion. It would be interesting to see this worked out in detail, although personally I find it hard to reconcile the observational facts (persistence of red spot, etc.) with the possibility of Jupiter's atmosphere being convective down to a pressure of a million atmospheres.

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The Rarer Constituents of South African Fireclays

SOME time ago I discussed the occurrence of vanadium and molybdenum in clays[1]. In their comprehensive and often neglected work on the refractory clays of Great Britain, Ennos and Scott[2] reported the presence of various uncommon elements. Vanadium, barium, lithium, manganese, phosphorus, etc., are mentioned. Cobalt, nickel and chromium oxides were reported in traces. Apparently all the work was done chemically.

The following is a résumé of work on two clays and is typical of what is obtained on South African specimens.

Element	Lines examined (A.)	Fireclay from Middelburg, Transvaal	Fireclay, Boksburg
V	3183·42	Distinct	Distinct
	3189·41	Distinct	Distinct
Be	2348·62 3130·56	Very faint	Very faint
Cu	3247·55	Very faint	Nil

Care was taken that impurities in the carbon rods did not vitiate the results. A large automatic quartz spectrograph was used and a great deal of experimenting done to ensure that exposures and current strengths were adequate. In this work barium, tin, etc., were carefully looked for, but were not found. In fact, the ultimate chemical composition of these fireclays is very simple.

Manganese was tested for, both chemically and spectrochemically. Ennos and Scott reported manganese in British fireclays in amounts from a trace to 0·31 per cent MnO. Only in one case was this element noticed in a South African clay, and this was due to local deposition from downward percolating waters which had leached out the manganese oxides from the soils above. Mixed oxides of iron and manganese were deposited along the cracks and joints of the fireclays. However, away from the contaminated zones the same clays did not contain a trace of manganese. It was also noticed that the wet and dry tests for this element were very much more sensitive than spectrochemical ones.

Ennos and Scott reported the presence of chromium in Scottish clays in amounts up to 0·11 per cent Cr_2O_3. This element has so far not been detected in the clays of South Africa.

From the numerous analyses made it is evident that the detection of many of these elements requires special technique. For example, the heavy residues should be separated, and zirconium, barium, chromium, etc., looked for there. The extraction of vanadium and molybdenum after calcination has already been discussed. Spectro-chemical analysis in itself is not sufficient to report the absence of an element. It must be confirmed chemically.

Sulphur and phosphorus have always been found to be present in South African fireclays, by chemical means. Carefully made blanks are absolutely necessary in any work of this kind.

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[1] Bosazza, V. L., NATURE, 146, 746 (1940).

[2] Ennos, F. R., and Scott, A., *Spec. Rep. Min. Res. Gt. Brit.*, p. 84 (1924).

RESEARCH ITEMS

Anthropological Connexions between America and Siberia

A. Hrdlička discussed this connexion at the annual meeting during April 28–29 of the U.S. National Academy of Sciences. Since 1926, under the auspices of the Smithsonian Institution, systematic anthropological researches and excavations have been carried on in Alaska. It was possible in 1939 to supplement the study of the collections, thanks to the Soviet authorities and men of science, with that of approximately 600 crania of various Siberian populations, from the Neolithic times onward. As partly reported to the Academy at its last annual meeting, the Neolithic skulls from the Angara and upper Lena region showed remarkable similarities with the oblong type of skull of the American Indian. It is now possible to supplement this with more evidence. The total is based on approximately 4,000 normal adult crania, the essential metric data on which are now ready for publication. These data show definitely a close affinity between the aboriginal Siberians and Americans. In some instances the relation between a Siberian and an American group is so close as practically to amount to identity; and similarly some of the Old Alaskan resemble certain mainland American groups. The evidence now available makes it possible, in brief, and besides the Neolithics who have already been discussed, to identify the Eskimo with the Chukchi, and the Aleuts with the broader headed type of the Tungus; nor do the resemblances stop there. In addition, the crania of the newly discovered Pre-Aleuts are seen to show a very near resemblance to the Siouan type; those of the similarly newly found Pre-Koniags of the Kodiak Island to the Algonkin type; and those of the Koniags, the people found on Kodiak at the advent of the Russians, with the southern Indian Alaskans. Thus, from the physical point of view, which alone can be reliable in the classification of human groups, America may now be definitely connected with Siberia, and Alaska with the rest of America.

Hormones Capable of Increasing Liver Fat

These hormones were discussed by O. Riddle and D. F. Opdyke on April 29 at the annual meeting of the U.S. National Academy of Sciences. Hormones derived from the ovary, pancreas, adrenal and especially from pituitary glands have been studied with reference to their ability to increase the storage of fat in the livers of young pigeons and rats. Since unlike results were obtained with these two species, this report is restricted to effects produced in pigeon livers following daily treatment during 2–4 days. Neither luteinizing hormone, adrenotrophin, intermedin, nor the inseparable mixture of gonadotrophin and thyrotrophin increases liver fat when those hormones are used in the purest form now available. Prolactin usually, but inconsistently, increases the liver fat in pigeons (not in rats), though it regularly increases the size of hepatic cells in pigeons. Insulin, desoxycorticosterone acetate and œstrone all increase liver fat. Anterior pituitary fractions obtained by ammonium sulphate precipitation, with dialysis of precipitates formed at one-third (and one-half) saturation, have resulted in appreciable concentration of liver fat activity in the water-soluble portion of the precipitate formed at one-third saturation. This fraction contains notable quantities of adrenotrophin, thyrotrophin, gonadotrophin and (traces of) posterior-lobe hormone, but it is almost free from prolactin. The 'pseudoglobulin' fraction (that is, the water-soluble part of the precipitate formed at one-half saturation) obtained in this series (done according to Young, 1939), though contaminated in fairly equal degree with all the hormones listed above for the highly potent fraction (and likewise almost free from prolactin), is practically free of liver fat activity. Pituitary extracts apparently show liver fat activity in all or many species, but it is not probable that this activity is produced by a single substance and not yet proved that an extract which is effective in one species is widely effective in others.

Sex-determination in the Earwig

Forficula auricularia has eleven pairs of autosomes (H. G. Callan, *J. Gen.*, **41**, 349–374; 1941), and there are two types of males: x, Y, and x_1x_2Y, and three types of females: x_1x_1, $x_1x_1x_2$, and $x_1x_1x_2x_2$. In the x_1x_2Y there may be a trivalent or a bivalent and univalent. The Y chromosome is dicentric and aids in the orientation of the trivalent during meiosis but may sometimes fragment and nondisjoin during the spermatogonal mitoses. The Y chromosome may be lost with high frequency. The prevalence of the twenty-five chromosome male x_1x_2Y in a population may have a selective advantage in giving rise to more females than males; in a dense population, one male may be sufficient for many females. The evolution of the sex-determining mechanism in Anisolabis and Forficularia is traced, and the presumed homology of the chromosomes x_1, x_2 and Y is suggested.

Polydactyly in the Fowl

D. C. Warren (*J. Hered.*, **32**, 3–5; 1941) has reported a further case of inherited polydactyly in the fowl. The character has been named duplicate, since in extreme cases the foot and shank are doubled. There is considerable variation in this dominant character, ranging from an appearance similar to that of a normal five-toed race to an almost complete duplication of the foot. Matings between a homozygous dominant and a heterozygous individual gave 2 normals in 144 individuals, indicating that as in the classic type of polydactyly the heterozygous individual may not show the abnormality. From crosses involving duplicate and polydactyly, it is believed that duplicate is an allelomorph of polydactyly.

Hybrids of the Maple

O. M. Freeman has crossed *Acer rubrum*, the red maple, and *A. saccharinum*, the silver maple (*J. Hered.*, **32**, 11–14; 1941). The hybrids were intermediate in rates of growth between the parents and had a dense amount of foliage. The leaves of some of the hybrids have holes in the leaves corresponding in position to the deep sinuses of the leaf of the silver maple. Of fourteen plants which flowered, ten were staminate and four were pistillate. The chromosome number of the red maple may be 36, 54, or 72, whereas the silver maple has 26 chromosomes. Several second generation plants are being raised.

Relative Position of Cell Walls in Developing Plant Tissues

THIS topic was discussed by E. W. Sinnott and R. Bloch on April 28 at the annual meeting of the U.S. National Academy of Sciences. In growing plant tissues the position of new cell walls is not fortuitous but has a definite relation to the position of walls already present in adjacent tissues. There are two main types of relative wall position: (1) Most commonly, a new wall avoids intersecting an old one at a point directly opposite the point of insertion of an adjacent partition wall, so that the walls alternate or 'break joints' and only three meet at a point. This type can best be studied in tissues where the cells are in parallel rows and all new walls are in one plane. In such cases the degree of avoidance can be shown graphically. (2) In certain tissues just the reverse condition occurs, a new wall being formed directly opposite the point of insertion of a previous one, so that four walls meet at a point. This is frequently found in the cortex of roots, in polyderm and in normal and regenerative periderm. Developmental studies show that the factors determining the position of the wall do so very early by controlling the position of the plate of cytoplasmic strands, or phragmosome, long before the wall itself is laid down. For this and other reasons the liquid film hypothesis, commonly invoked to explain the alternating type of wall position, is regarded as inadequate. The opposite type of wall position seems to be related to local changes in the character of the mother-cell wall. Apart from their bearing on the general appearance of plant tissues, these facts are of significance in problems dealing with tissue cohesion, the production of aerenchyma, and the number of faces of contact between cells.

The 'Great Dyke' of Southern Rhodesia

THE mystery of the geological structure of the 'Great Dyke' has been a challenge to geologists ever since 1870, when this immense intrusion was first recognized. A summary of our knowledge of the 'Great Dyke' has been given by B. Lightfoot in a recent presidential address (*Proc. Geol. Soc. S. Africa* for 1940; 1941) in which he suggested that geophysical methods might supply some of the missing information. As a result of this call for specialized research, O. Weiss and his colleagues have carried out gravimetric and earth-magnetic measurements (*Trans. Geol. Soc. S. Africa*, **43**, 143–151; 1941). The gravity anomalies are the largest ever published over similarly narrow widths on any continent, their maximum being 46·7 and 54·0 milligals on the two traverses made. The evidence proves the existence of a heavy, slowly tapering and very deep linear core below the exposed rocks. The core has an average density of about 3·3, and it is considered to be peridotite or possibly pyroxenite. It is suggested that the name 'dyke' is not appropriate and that the term 'abyssolith' would more accurately describe this enormous injection. It is remarkable that over the core of the abyssolith no major magnetic anomaly has been found, indicating that the core contains no appreciable proportion of magnetic minerals. Since magnetite is abundant in the serpentines of southern Africa, including those of the surface exposures of the abyssolith, the evidence supports the conclusion that serpentinization has not affected the core. Weiss suggests that the superficial serpentinization was due to hydration by waters of meteoric origin. It is to be hoped that similar geophysical exploration may be extended to the Bushveld Complex, with a view to the discovery of the location and structure of the feeder or feeders of that still more amazing assemblage of igneous rocks.

Radioactivity of Ocean Sediments

SINCE Joly's early investigation of the radium content of samples of deep-sea deposits from the *Challenger* Collection it has been known that such deposits are extraordinarily rich in radium, the concentration being four to ten times that found in average granite. Later work has shown that there is much less radium in ocean water and much more in the abyssal sediments than is appropriate to the uranium present in the same materials. C. S. Piggot and W. D. Urry have studied core samples of abyssal deposits, several metres long (*Amer. J. Sci.*, Feb. 1941). It is found that the high concentrations of radium are purely superficial and do not extend to any appreciable depth below the ocean bottom. At a point but a few metres down, the radium falls to a value which corresponds to the amount in equilibrium with the uranium present, an amount which is of the same order as that in ordinary sediments. Thus, there is no greater generation of heat by radioactivity over the ocean floor, to blanket the flow of heat from below, than there is in the continental rocks. Evidently there is some mechanism whereby radium, and also its immediate parent ionium, is abstracted from the ocean water, leaving most of the uranium behind. The ionium produces more radium, and the excess of these two elements in the bottom sediments, unsupported by uranium, eventually disappears. Various mechanisms that have been proposed to account for the abstraction—biological, chemical and physical (adsorption or base exchange)—are critically reviewed, and it is shown that while some are inadequate, others, notably the physical, have not yet been given the consideration they deserve. More data are essential before the problem can be solved.

Disintegration of Boron by Slow Neutrons

THE disintegration of boron by slow neutrons has been investigated by R. S. Wilson (*Proc. Roy. Soc.*, A, **177**, 382; 1941) using an ionization chamber filled with boron trichloride in conjunction with a linear amplifier. Evidence is found for two disintegration energies. Assuming that the greater energy release corresponds to the formation of the ^{7}Li nucleus in the ground state and is therefore 2·99 Mev., then the smaller energy, which is released in about 93–94 per cent of the disintegrations, and is 2·57 ± 0·05 Mev. An explanation is offered of the contradiction with the results of Maurer and Fisk. The γ-radiation associated with the reaction has been detected, and a rough measurement of its quantum energy has been made.

Magnet for Cosmic-Ray Cloud-Chamber Studies

THE design and characteristics of a magnet for cosmic-ray cloud-chamber studies were described by R. B. Brode on April 28 at the annual meeting of the U.S. National Academy of Sciences. The study of cosmic-ray mesotrons requires a magnet that will appreciably deflect particles of an energy of 10^{10} electron-volts. The operation of a Wilson cloud-chamber requires long periods of operation at constant temperature. The design and dimensions of a magnet for this purpose were determined by studies on small models. In the final magnet 5,300 pounds of steel were used in casting the yokes and 2,700 pounds of copper wire were used in the coils. To reduce the saturation in the steel, the poles were coned from a diameter of 18 in. to a diameter of 12 in. in ten inches distance. The front pole has a conical hole in it that permits the cloud-chamber to be photographed directly without the use of mirrors. The hollow centre of the front pole throws flux from the centre towards the outside so that the flux-density as measured in the illuminated plane of a cloud-chamber 30 cm. in diameter is constant to within 5 per cent. The coils were wound with No. 6 square double-glass-covered copper wire. The turns were cemented together with an air-drying binder. Cooling is provided by the circulation of water in four layers of copper tubing in each coil. Six kilowatts obtained from the direct-current supply system produced an average field of over 9,000 gauss. In spite of the large hole in the front pole the equivalent air-gap of the magnet is only 14 cm.

Experiments with Mesotrons in a Large Wilson Chamber

STUDIES bearing upon the production and disappearance of mesotrons have been made by R. P. Shutt and T. H. Johnson in a large Wilson chamber containing three lead plates. These were described by the latter on April 28 at the annual meeting of the U.S. National Academy of Sciences. Since the observational data consist of the directions and the densities of the tracks before and after the traversals, whereas the processes of interest occur within the lead plates and are not observed directly, the method is essentially statistical. A pair of mesons, originating in a lead plate with no visible particle entering above, would be evidence of the production of mesons by gamma rays, but no events of this nature have been observed although many would have been expected if the hypothesis were tenable that gamma rays in the upper atmosphere are the principal producers of mesons. The ratio of the number of slow mesons with dense tracks in the gas to the number stopped by the lead plates agrees with expectations based upon the ionization losses and gives no indication of other absorptive processes. The scattering of the mesons by the lead is also that predicted for the coulomb forces, and gives no indication of extraordinary forces acting between mesons and lead nuclei. If mesons are being stopped by processes other than ionization, the statistics obtained from 10;000 tracks traversing the lead are insufficient to put such processes in evidence, and it will be necessary to adopt a technique in which the individual events are observed directly in a dense gas. For this purpose the authors are constructing a cloud chamber 12 in. in diameter to operate at a pressure of 200–300 atmospheres. This chamber will be immersed in a transparent oil contained in a thick-walled steel tank. Photographs will be made through a thick glass window the size of the camera lens, and the chamber will be illuminated by arcs placed inside the tank. When filled with argon this chamber will have a cosmic-ray stopping power equivalent to 7 cm. of water or nearly 1 cm. of lead.

Phosphoryl Bromide

THIS compound, $POBr_3$, has previously been obtained with difficulty, some of the reactions leading to explosions. C. R. Johnson and L. G. Nunn (*J. Amer. Chem. Soc.*, **63**, 141; 1941) have found that phosphorus tribromide vapour may be oxidized rapidly yet non-explosively to the oxybromide by gaseous oxygen in the presence of nitric oxide. It is concluded that the oxidation is catalysed by N_2O_4 and not by NO_2. The effect of various factors on the velocity of the oxidation was studied but the paper omits to give any practical details for the isolation of the phosphoryl bromide.

Gratings and Replicas for Astrophysical Research

AN account of the improvements made in reflecting gratings which have resulted in their adoption in place of prisms in the large spectrograph of the 100-in. telescope on Mt. Wilson and elsewhere was given by R. W. Wood on April 28, at the annual meeting of the U.S. National Academy of Sciences. Batteries of large replica gratings have been made and tested on the 18-in. K. Schmidt star camera on Mt. Palomar with excellent results, and 18-in. disks of glass are now in preparation which will carry elementary gratings 4 in. × 6 in., covering the entire aperture of the instrument. Excellent photographs of the spectrum of Arcturus were obtained in ·10 seconds with a replica having 7,500 lines to the inch, covering a Schmidt camera of 3-in. aperture and 5-in. focus, and one of the ring nebulæ in Lyra in 10 minutes. A new combination of two gratings and two prisms, covering the objective of a telescope, gives two spectra of each star, in coincidence, one above the other, and displaced in opposite directions by Doppler shift due to stellar velocities. Gratings of both types have been made giving as high as 85 per cent of the light in a single spectrum.

Reddening of Stars near the North Pole

THE scale of normal colours of the stars is based on observations of the stars in the North Polar Sequence. It is unfortunate but not irremediable that when these stars were selected as standards it was not known that interstellar absorption near the pole appreciably reddened their light. The 1938 report of the International Astronomical Union estimated this reddening to amount to 0·10 mag. A paper by Keenan and Babcock, however (*Astrophys. J.*, **93**, 64; 1941), suggests that at least part of the reddening is only apparent: that it is not due to absorption, but occurs because the polar standards have been classified from 1 to 2 spectral subdivisions too early. They reclassify on spectrograms taken specially for the purpose 75 stars in the polar cap, and compare their photo-electric colours with those of 37 bright stars of such high galactic latitude that they can be regarded as unreddened. The colour excesses thus found can best be represented by assuming that absorption does not set in until a distance of about 200 parsecs is reached, the reddening then increasing to 0·04 mag. at 400 parsecs. Nevertheless, the data do not preclude the possibility of an absorption coefficient increasing linearly with distance. Whichever interpretation is finally accepted, however, the paper makes available for future research a valuable list of polar standard stars the deviations of which from normal colour are now accurately known.

THE ACCRA EARTHQUAKE OF JUNE 22, 1939

THIS earthquake, which caused the deaths of seventeen people and injury to upwards of 135 others, besides doing damage to buildings to the extent of hundreds of thousands of pounds in Accra, the capital of the Gold Coast and the surrounding country (NATURE, 144, 18; 1939), has recently been the subject of comprehensive research*. The Gold Coast as a whole is a relatively stable region and earthquakes are rare, though the Accra district and the coastal area to the east and west are subject to earthquakes. Major shocks occurred in 1862, when every stone building in Accra was razed to the ground and Christiansborg Castle and the forts at Accra taken over by the British from the Danes twelve years before, were rendered uninhabitable; in 1906 when on November 20 Government buildings in Accra were damaged though no casualties were reported; and in the present instance. Recorded minor shocks occurred in 1636, 1858, 1863, 1883, 1907, 1911, 1918–19, 1923, 1925, 1930 and 1933–35.

There are no records of any minor precursor shocks to the 1939 earthquake since the operation of the seismograph at Accra had been discontinued a few years previously on the grounds of economy; but between 1932 and 1935 cracks began to appear in substantial Government buildings in Accra and in the ground near the buildings. At the time Dr. Junner directed attention to the possibility of earthquakes occurring within the next 10–15 years. The earthquake of June 22, 1939, occurred at approximately 7.20 p.m. (G.M.T.) and was felt for about 20–30 seconds at Accra. There is no doubt that casualties were fewer than might have been expected from the severity of the shock since at the time many people were out of doors and there were no subsequent outbreaks of fire. The earthquake was felt by persons over an area of approximately 300,000 square miles and at places more than five hundred miles from Accra. As the epicentre was probably out to sea some twenty-five miles from Accra it is likely that it would have been felt over an area of 600,000 square miles if the whole of the area had been populated land.

According to a geological and engineering survey conducted immediately after the shock and a study of the answers to a questionnaire circulated in the area, it appears that the maximum intensity reached on the modified Mercalli scale was 9 (probably 10 at the epicentre). Accra experienced intensity 8. The villages within isoseismal 9 consisted almost entirely of swish buildings or of grass huts. In Aplaku, situated on Akwapimian quartzite near the Sakumo lagoon, ten houses were razed to the ground and most of the others lost walls facing north-west or south-east. Nyanyanu, similarly situated, was almost completely ruined, and in addition the north-west sides of all the cylindrical fish-drying kilns in the village were forced out. The small villages of Amanfro, Tokuse and Tetegbu, situated on alluvium, suffered much damage. A line of fissures in alluvium and earth with, in places, a downthrow to the south-east of 9–16 in. stretched from Fete to Weija, and another series of fissures was formed in the sand on the sand spit south of Sakumo lagoon. Near Tokuse the fissures were, in places, up to 15 ft. wide. Villages on the north-western side of the fissure were only slightly damaged while those on the south-east side of it were ruined. Small cracks also occurred in several places in made-up ground and rarely in weathered Akwapimian quartzite. Scores of vents and fissures from which water, sand and mud poured for several hours occurred along the western and southern sides of the Sakumo lagoon. The water works at Weija (intensity 8) were seriously damaged.

At Accra during the earthquake a loud and sustained rumbling was heard and some found it difficult to walk. The sea is said to have become rough and fishermen at Labadi and Teshi say their canoes shivered and that they lost control for a time. The earthquake was just short of world shaking according to the evidence of seismographs. As a result of the examination of the seismograms obtained at about sixty observatories throughout the world where the shock was recorded, a least squares solution using the P waves alone gave:

Initial time = 19h. 19m. 25·8s. ± 1·0s. G.M.T.
Latitude = 5·18° N. ± 0·03°
Longitude = 0·13° W. ± 0·03°
Depth of focus = 13 km. ± 2 km.,

probable errors being given. These results were checked by statistical methods, by readings of other pulses, and by the macroseismic evidence. The energy of the earthquake was of the order of 10^{19} ergs. From June 22, 1939, until July 11, 1940, ninety-four aftershocks have been recorded, these showing a distinct diminution in frequency as time progressed, with the possible exception of February 12, 1940, when eight occurred.

In view of the seismic history of the district, the geological evidence concerning the 1939 earthquake and the engineering aspects of the earthquake, which showed that failures in structures were often due to poor materials, poor construction or poor design, certain recommendations have been made for the rebuilding of Accra. It has been suggested that Government headquarters should be transferred to a more central and more suitable site than Accra. The advantages of such a transfer would probably outweigh the disadvantages except that the initial cost would be very great. If it is impracticable to move from Accra it is of the greatest importance that rebuilding and future building should be, so far as is possible, on sites favourable from the geological point of view to withstand earthquake shocks, and that buildings and other structures should be designed and constructed in such a way that the effects of earthquake shocks will be reduced to a minimum. It should not be necessary, however, to build special earthquake-proof structures except for large buildings on unfavourable sites, and for essential public works such as reservoirs and power stations. From the geological point of view the area east and north-east of a line from Christiansborg police station to Okplonglo is considered to be the most suitable for rebuilding and future building programmes. Stricter control and supervision of the design and construction of all buildings other than single-story, inferior-type buildings is advocated, and the following facts, together with others, based largely on the experience gained in regions subject to severe earthquakes, should be taken into account when permanent rebuilding at Accra is being considered:

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* Gold Coast Geological Survey Bulletin 13: 'The Accra Earthquake of 22nd June 1939'. By Dr. N. R. Junner and other authors. Pp. 67. (Accra: Geological Survey; London: Crown Agents for the Colonies, 1941.) 3s.

(*a*) A building should be of simple design and should be so constructed that it will move as a whole in an earthquake.

(*b*) Buildings should be as nearly square and as low as is conveniently possible.

(*c*) Foundations should be strong and deep.

(*d*) All unnecessary ornamental work should be avoided.

(*e*) Walls should be light and strong. Arches and windows are a source of weakness.

(*f*) Roofs should be light and rigid and should not be steeply inclined.

(*g*) Piers may be a great source of weakness. Arched piers should not be used, and all piers should be constructed to withstand an acceleration of at least 3 ft. per second from any direction; in other words, the width at the base of the pier should be at least one tenth of the height of the pier. Tapered piers are advisable in seismic areas and stronger cement may be used near the base of a pier.

(*h*) Well-constructed wooden buildings will oscillate greatly but will withstand anything but very severe earthquakes unless the structures are built on unconsolidated materials.

(*i*) Good-quality building materials and workmanship are essential.

(*j*) Inferior-quality buildings should not be of more than one story.

RECENT RESEARCHES ON RUBBER

RUBBER FRACTIONS

PUBLICATIONS Nos. 3–6 of the British Rubber Producers' Research Association follow a well-beaten track with interesting new details. On the general principle that rubber is a mixture of molecules of different lengths, several previous investigations have attempted to sort the molecules out either by fractional precipitation from solution or by fractional dissolution. A division into 'sol' and 'gel' rubber on these lines has become more or less standard. G. F. Bloomfield and E. H. Farmer (*Inst. Rubber Ind. Trans.*, **16**, 69; 1940) have adopted fractional extraction as their mode of approach, using mixtures of petroleum ether and acetone as extractant, differentiating the fractions in relation to the increasing proportion of petrol in the extracting mixture. Oxygen was rigidly excluded at all stages, but it may have been unfortunate to add β-phenylnaphthylamine to the extraction mass; this compound is an anti-oxidant for vulcanized rubber, but may act in some conditions as an oxidation promoter for raw rubber.

Four distinctive fractions were taken at arbitrary points—a first small one containing appreciable combined oxygen; a second fraction comprising a pure hydrocarbon of relatively low molecular weight; a third, also pure hydrocarbon, of higher molecular weight; and a fourth containing appreciable combined nitrogen. There was also an insoluble residue. Different types of raw rubber gave different proportions of extract, and at various compositions of the mixed solvent, so that there is little that can be said of a conclusive nature about the make-up of rubber in relation to this extractant.

However, G. Gee and L. R. G. Treloar (*Inst. Rubber Ind. Trans.*, **16**, 184; 1940) have examined several properties of some of these fractions with results of considerable interest. Using methods previously described (Gee, *Trans. Faraday Soc.*, **36**, 1162, 1171; 1940), the molecular weights of the four fractions, in a particular case and from viscosity data, were found as 63,000, 240,000, 350,000 and 360,000. Experimental technique is not yet available to decide whether these, or some of them, represent well-defined classes of uniform length molecules, or merely average 'cuts' in a continuous range of molecular lengths. Several of the properties measured varied in a systematic way with the molecular weight, as for example, the plastic flow, tensile behaviour, crystallization phenomena, and extensibility range. Properties independent of molecular weight seem to be the temperature at which retraction occurs after extension to produce crystallization, and the low-temperature elastic limit. It is particularly interesting to observe that the physical properties of the third fraction are remarkably similar to those of normal crêpe rubber, indicating clearly that the usual elastic properties of (raw) rubber are not dependent on the presence of either low-molecular constituents or 'gel-skeletons'.

PROTEINS IN HEVEA LATEX

Publication No. 2 of the British Rubber Producers' Research Association brings out a marked resemblance between rubber latex protein and typical leaf proteins. The following table, from G. R. Tristram (*Biochem J.*, **34**, 301; 1940), compares his analyses with leaf protein analyses by Chibnall:

	Amino-acids as percentage protein	
	Latex	Various leaves
Ammonia	1·46	0·97– 1·17
Arginine	6·90	7·1 – 8·2
Lysine	5·68	4·6 – 6·2
Histidine	0·63	1·0 – 1·6
Glutamic acid	13·68	11·4 –14·0
Aspartic acid	10·5	7·9 – 8·8
Tyrosine	7·24	4·8 – 6·1
Tryptophan	1·49	2·1 – 2·4
Methionine	1·12	2·2 – 2·7
Cystine	1·02	1·4 – 2·2
% Total nitrogen	14·95	12·8 –15·0

The similarity in the two sets of figures undoubtedly suggests some relationship between the proteins in the leaves and latex of *Hevea brasiliensis*, and the question is being pursued by way of analyses of proteins from Hevea leaves themselves.

J. McGavack and C. E. Rhines (*Ind. Eng. Chem.*, **32**, 1072; 1940) recently showed that the nitrogen content of "whole latex" is approximately constant at 0·25 per cent, the analyses being of 117 samples, collected in a single month (thus avoiding seasonal variation) from many types of tree. There is a suggestion in this constancy that the tree produces some nitrogenous compound to an optimum concentration, either as an auxiliary to the synthesis of caoutchouc or as a side product of that synthesis. Tristram's results thus throw an interesting light on such a suggestion, indicating the place of these reactions as in the Hevea leaves, a natural site for photosynthetic transformations. Further results in this field will be awaited with impatience.

THE 200-IN. TELESCOPE

THE twelfth Thomas Young Oration was delivered before a meeting of the Physical Society by Dr. H. Spencer Jones, Astronomer Royal, on May 30. He described some features of the 200-in. telescope now being constructed for the California Institute of Technology.

This telescope was made possible by a grant of six million dollars from the Rockefeller General Education Board. The design and construction of a telescope of double the aperture of the largest telescope previously built required careful consideration of a large number of problems. The primary problem was the construction of a 200-in. mirror. If made, in accordance with previous practice, of a solid block of plate glass, annealing for nine years would have been required. Mirrors of stainless steel or of metal coated with glass of the same coefficient of expansion were considered but were regarded as too experimental; fused quartz with a surface coating of clear quartz was tried but abandoned, not because the difficulties were insuperable but because the cost would have been too great. A special pyrex glass of high silica content, with a coefficient of expansion only three times that of quartz, was finally decided upon. The disk was cast, by a special technique evolved after much experimental work by the Corning Glass Company, with a ribbed honeycomb structure at the back to reduce the weight without sacrifice of rigidity. Annealing for ten months proved to be adequate for this special glass. The disk weighs 14½ tons and its optical figuring is well advanced.

The mounting embodies many new features. It is of a modified yoke type, the upper bearing being in the form of a giant horseshoe, 46 ft. in diameter, within the throat of which the telescope can lie for observations at the north pole of the sky. Only one machine in the world was large enough to machine this bearing. The yoke arms are hollow cylinders, 10 ft. in diameter, joined by a bent box girder 46 ft. long, which carries the hemispherical thrust bearing, 7 ft. in diameter. An oil pad flotation system enables the 450 tons of the moving parts to be turned with a torque of only 50 lb.-ft. The primary focus is at $f/3 \cdot 3$ and the observer makes his observations within a 6-ft. diameter cylinder, supported from the upper cage of the tube. The Cassegrain focus is at $f/16$ and observations can be made either at a focus just below the central hole of the 200-in. mirror, where there is a platform for the observer, or, by the interposition of a diagonal flat mirror, within either of the hollow yoke arms. The Coudé focus is at $f/30$, and observations with high dispersion spectrographs can be made within a constant-temperature room just south of the telescope. At the primary focus, coma would be serious at a small angular distance from the axis; two special correcting lenses of zero power have been designed to eliminate coma. For observations of faint objects, with low-dispersion spectrographs, two special short-focus camera objectives of great relative aperture have been constructed; one of these, with relative aperture of $f/0 \cdot 35$, on the principle of the oil-immersion microscope objective, is of British design and construction. The ingenious image-slicer, designed by Dr. Bowen, will give a greatly increased efficiency in all spectrographic observations.

All auxiliary mirrors are permanently carried on the mounting and can be operated by remote control. The telescope drive is of an elaborate nature; the effects of changing refraction, of differential flexure and of errors in the gears are automatically allowed for by a system of 'computers'. A quartz-crystal oscillator provides the fundamental control of the rate of drive. A complicated system of Selsyn or interlock motors enables the telescope to be set rapidly to any predetermined position, the position of the dome and of the windscreen being automatically adjusted.

WIRED RADIO BROADCASTING

WIRED broadcasting has already appeared in service in Europe and other parts of the world. An article written by N. Shinohara and Y. Hirano, of the Ministry of Communications, Tokyo, in the January issue of the *Nippon Electrical Communication Journal*, a summary form in English of the journal of the Institute of Electrical Communication Engineers of Japan, discusses the subject, stress being laid on experiments and the basis of network design.

In one method, a wireless radio receiving and wired radio transmitting station is located at a position near a crowded area of listeners or in a suburban district, where there is little electrical disturbance. The programme received at this station is converted to audio-frequency and sent over special lines to the listeners. This method is known in Japan as an ordinary form of common broadcast reception. The programme is distributed at a fairly high level of volume, so that it is only necessary for the listener to instal a loudspeaker. The resulting low cost of the receiving apparatus is an advantage. The disadvantages, however, accompanying radio-broadcasting cannot be avoided, because this method has an intermediate wireless system. Also a large expenditure of money and materials is needed for the installation of special lines to listeners.

A second method makes use of telephone lines, to which the broadcast programme is supplied at audio-frequency. While this method greatly increases the efficiency of utilization of the telephone lines, the programme is subject to interruption by telephone calls, and it is found that a high level of broadcasting power, such as is used in the first method, cannot be transmitted directly through the lines.

A third method makes use of telephone lines, or lighting and power distribution lines, on which the programme is superimposed by means of a high-frequency carrier wave. In Japan this method has been adopted as the basic principle on which a wired broadcasting network may be established. While the percentage of telephone installations in Japan is low, the percentage of electric lighting is very high, being about 90 per cent, which is second to Switzerland's 99 per cent. The use of lighting and power lines together with telephone lines, therefore, would make it possible to develop an almost complete country-wide network.

Experiments on wired broadcasting in Japan have been going on since 1926 in the form of a carrier system over power and lighting lines. In 1935, broadcasting on high-frequency carriers was proposed by the Ministry of Communications. It is interesting to note that when wired broadcasting on high frequencies was introduced, the aims stressed were the relieving of the congestion in allotted wave bands due to the development of broadcasting, and the distribution of clear, stable, high-quality programmes. In the present crisis, the mission of wire broadcasting has been extended to the important tasks of protecting broadcasts from outside interception and preventing false broadcasts.

In surveying the possibilities in Japan of telephone lines as circuits for wired broadcasting it is found that the number of telephones per 100 persons is 3·80 in cities having populations of 50,000 or more, and 0·84 in towns of smaller population; hence the reception of broadcasts over telephone subscribers' lines is effective only in cities having a high percentage of subscribers. The use of telephone lines is especially necessary in cities where power cables are employed for supplying electricity. Thus telephone lines ought to be utilized as much as possible in the busiest sections of a city and in districts where power cables are used, whereas overhead power and lighting lines ought to be used in the suburbs, in towns and villages, and in cities having overhead power distribution lines. It was considered best to standardize the carrier frequency at 130 kilocycles. This value would be the frequency for the distribution of wired broadcasts to listeners all over the country.

FORTHCOMING EVENTS

[*Meetings marked with an asterisk are open to the public.*]

Tuesday, June 17

INSTITUTE OF PHYSICS (London and Home Counties' Branch) (in the Lecture Hall of Messrs. Kodak, Ltd., Harrow), at 6 p.m.—Dr. D. A. Spencer: "The Applications of Photography in Engineering".

Wednesday, June 18

BIRKBECK COLLEGE (Bream's Buildings, Chancery Lane, London, E.C.4), at 6 p.m.—Foundation Oration by His Grace the Lord Archbishop of York: "Education and Peace".

Thursday, June 19

CHADWICK PUBLIC LECTURE (at the Chelsea Physic Garden, Swan Walk, London, S.W.3), at 4 p.m.—Dr. J. Ramsbottom: "The Inter-relation of Man and Fungus in Health and Disease".*

ASSOCIATION OF SCIENTIFIC WORKERS (Birmingham Branch) (at the University, Birmingham), at 7 p.m.—Prof. J. D. Bernal, F.R.S.: "Science and Society".*

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

HEAD OF THE ELECTRICAL SECTION of the Engineering Department of the Oldham Municipal Technical College—The Director of Education, Education Offices, Oldham (June 20).

BOROUGH ELECTRICAL ENGINEER—The Town Clerk, Town Hall, Woolwich, London, S.E.18 (June 21).

LECTURER IN GENERAL SCIENCE including BIOLOGY and GARDENING—The Principal, St. John's Training College, York (June 23).

DEPUTY BOROUGH ENGINEER AND SURVEYOR—The Borough Engineer and Surveyor, Town Hall, Barking, Essex (June 24).

PRINCIPAL OF THE CAMBRIDGESHIRE TECHNICAL SCHOOL—The Education Secretary, Cambridgeshire Education Committee, Shire Hall, Cambridge (June 24).

LECTURER IN THE MECHANICAL AND CIVIL ENGINEERING DEPARTMENT—The Secretary, Technical College, Sunderland (June 28).

ASSISTANT TO THE ENGINEER-IN-CHIEF—The General Manager and Secretary, Mersey Docks and Harbour Board, Dock Office, Liverpool (June 30).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology, No. 14: Concerning the Upward Movement of Soil Solutes, by T. G. Mason and E. Phillis; Studies on the Partition of Mineral Elements in the Cotton Plant, 2: Preliminary Observations on Potassium, Calcium and Magnesium, by E. Phillis and T. G. Mason; On the Expression of Sap by Low Pressure, by E. Phillis and T. G. Mason. Pp. 36. (London: Empire Cotton Growing Corporation.) 2*s*. 6*d*. [235

Other Countries

United States Department of the Interior: Geological Survey. Bulletin 899–B: Geologic Structure and Occurrence of Gas in part of Southwestern New York. Part 2: Subsurface Structure in part of Southwestern New York and Mode of Occurrence of Gas in the Medina Group. By G. B. Richardson. Pp. iii+69–93+plates 5–8. 30 cents. Bulletin 922–J: Chromite Deposits in the Seiad Quadrangle, Siskiyou County, California. By G. A. Kynearson and C. T. Smith. (Strategic Minerals Investigations, 1940.) Pp. iv+281–306+plates 40–44. 30 cents. Bulletin 922–O: Chromite Deposits of the Pilliken Area, Eldorado County, California. By F. G. Wells, L. R. Page and H. L. James. (Strategic Minerals Investigations, 1940.) Pp. iv+417–460+plates 66–69. 35 cents. Bulletin 922–P: Chromite Deposits in the Sourdough Area, Curry County, Oregon. By F. G. Wells, L. R. Page and H. L. James. (Strategic Minerals Investigations, 1940.) Pp. iv+461–494+plates 70–71. 30 cents. (Washington, D.C.: Government Printing Office.) [205

United States Department of the Interior: Geological Survey Professional Paper 196–A: Geology and Biology of North Atlantic Deep-Sea Cores between Newfoundland and Ireland. Summary of the Report; Foreword, by C. S. Piggott; General Introduction, by W. H. Bradley; Part 1: Lithology and Geologic Interpretations, by M. N. Bramlette and W. H. Bradley; Part 2: Foraminifera, by Joseph A. Cushman and Lloyd G. Henbest. Pp. xv+56+10 plates. (Washington, D.C.: Government Printing Office.) 30 cents. [205

United States Department of Agriculture. Circular No. 594: The Use of Traps against the Japanese Beetle. By Walter E. Fleming, Emory D. Burgess and Warren W. Maines. Pp. 12. 5 cents. Miscellaneous Publication No. 417: Bark Beetles of the Genus *Hylastes* Erichson in North America. By M. W. Blackman. Pp. 28. Technical Bulletin No. 757: Parasites of the Birch Leaf-Mining Sawfly (*Phyllotoma nemorata*). By Philip B. Dowden. Pp. 56. 10 cents. (Washington, D.C.: Government Printing Office.) [205

Proceedings of the United States National Museum. Vol. 89, No. 3101: The Polyclad Flatworms of the Atlantic Coast of the United States and Canada. By Libbie H. Hyman. Pp. 449–496. Vol. 89, No. 3102: New Species of Heterocerous Moths in the United States National Museum. By William Schaus. Pp. 497–512. Vol. 89, No. 3105: Notes on Birds of the Guatemalan Highlands. By Alexander Wetmore. Pp. 523–582. (Washington, D.C.: Government Printing Office.) [205

Nyasaland Protectorate. Annual Report of the Forestry Department for the Year ended 31st December 1940. Pp. 8. (Zomba: Government Printer.) 1*s*. [205

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PROPAGANDA IN EUROPE

IN the recent debates in Parliament, with their striking vindication of parliamentary institutions, and in particular of the value of the House of Commons as a direct supervisor of departmental activities, there have been two main points of criticism or concern. The first of these, the question of man-power and production, has already been discussed in these columns. The second, that of propaganda and the work of the Ministry of Information, including the British Broadcasting Corporation, acquires greater importance with the abandonment by Allied troops of their remaining foothold on the mainland of Europe, no less than with the latest agreement of the Vichy Government with Germany.

Much has been heard in the last seven months of the 'New Order' which Germany will introduce, or is introducing, in Europe. That design for a new economic order is becoming clearer and its features have been admirably outlined in recent publications*. There can be no question as to the urgency of meeting that challenge now in the diplomatic field as well as in that of arms, of exposing the real nature of the German 'New Order' and of expounding the alternative which we have to offer. To allow that challenge to go by default and to fail to refute emphatically and authoritatively the insinuation that we stand for the old order or disorder, and that our only aim is to restore the *status quo* in Europe and to maintain it at home, may do irreparable harm to our cause, both in Europe and overseas.

The publications already mentioned afford invaluable equipment for at least a part of that task. Mr. Duncan Wilson shows clearly how the new order has already meant the wholesale robbery of occupied Europe for the benefit of Nazi Germany, even to the point of actual starvation, and the forced mobilization of labour for Nazi war purposes. The scheme is to be forced on the world by ruthless war, for the exploitation of industry, capital and man-power from one end of Europe to the other, solely to increase the wealth and to strengthen the arms of the Nazis. The 'New Order' is only the old order of exploitation, successively manifested in Germany, the Balkans and the occupied territories of Western Europe since 1933.

Mr. Wilson, however, does not leave it at that. He points out how carefully this 'New Order' propaganda campaign, since Germany gained control of Western Europe in June 1940, is timed to fit in with a strategic plan. The Germans are playing skilfully on the general desire in Europe and America for economic stability, which they promise the 'New Order' will achieve. They do not mention the price of complete political subjugation to be paid by its victims in Europe, or the dominating position it would give to Germany in the markets of the world. They carefully conceal its weaknesses—the reaction in Germany and the occupied territories, and the strain which resistance is already placing on German administration, so that it is already fair to conclude that Hitler can no more bring peace to Europe than he cares to bring it freedom.

The Royal Institute of International Affairs fully corroborates, with its detailed analysis, Mr. Wilson's conclusions. Its careful examination of the German long-term plan for an economic new order in Europe and of the probable effects of its application with reference to the central trends and problems of European economy and the place of that economy in the world as a whole, is searching and authoritative, and is substantiated by an account of the German exploitation of the occupied countries which leaves no room for doubt as to the real nature of the oppression masquerading under the name 'New Order'.

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* "Europe under Hitler: in Prospect and in Practice." (London: Royal Institute of International Affairs.)

"Germany's 'New Order'." By Duncan Wilson. (Oxford Pamphlets on World Affairs, No. 46.) Pp. 32. (Oxford: Clarendon Press; London: Oxford University Press, 1941.) *4d.* net.

"Hitler's 'New Order' in Europe." By Paul Einzig. Pp. xii+147. (London: Macmillan and Co., Ltd., 1941.) *7s. 6d.* net.

"The Two Orders", *Round Table*, March, 1941. (London: Macmillan and Co., Ltd.) *5s.* net.

The evidence thus assembled shows clearly that the German policy is to incorporate in the Reich, or, where this is not expedient, to buy up, all the main manufacturing capacity of the Continent, and to trade on terms which may be pushed far in her own favour, with the purely complementary and raw-material producing countries outside her new boundaries. This policy involves the growing impoverishment of the rest of the Continent and the permanent exploitation of 70 per cent of the population of continental Europe, excluding Russia. Moreover, this policy is only part of a scheme for world domination. It appears to envisage putting Africa under the same subjugation, and its attitude to the western hemisphere is clearly that the new Europe is to be independent of the western hemisphere, trading on Germany's own terms purely as a means of raising standards of living above the necessary minimum.

"Europe under Hitler" shows clearly enough how the American peoples would suffer from this system, which would be no better for the outside world than for Europe. Fortunately, it has already been made plain that the United States are fully alive to the implications of such a permanent organization of 325 million people for the support of a war machine having at its disposal material resources almost as great as their own, and headed by men prepared to use it ruthlessly for any purpose which their ambition may suggest. It is by no means clear, however, that the British Government is alive to all the implications arising out of the facts and position disclosed in these analyses.

In the first place, it is of the utmost importance that we should expose to the utmost of our power the weaknesses and the fallacies of the German plan for Europe. Our propaganda must be as widespread and effective as the Nazis', exposing its falsehoods and encouraging the resistance in the occupied territories, which are already taxing Nazi strength and thwarting its purpose. Recent uneasiness about the Ministry of Information and British broadcasting has largely been due to doubts as to whether such propaganda is being carried out on a wide enough basis, and with sufficient purpose and skill to achieve its objective. There is insufficient evidence that it has been given its proper place in our war strategy and directed and executed with the vigour and enthusiasm essential to success.

The second point concerns the elaboration of British proposals for a new Europe. It would be most unwise to concentrate exclusively on exposing the negative sides of the German plan for Europe, glaring as they are. It would not even be an effective reply to his propaganda about our own exploitation of Europe and pretence that he is liberating Europe from the economic tyranny of Britain. Nor can we assume that liberating Europe from Nazi domination means reversing the whole process of economic integration which has been set in motion. We need a more unified Europe, but must attain it by other methods and for other purposes than those of the Nazis. The new order in Europe must seek to create new ties, not to dissolve old ones; to build up, not to destroy.

This is the truth which lies behind projects like the United States of Europe or Federal Union; the practical issue at the moment, however, is not the discussion of legal forms but the consideration of the fundamental issues of European order, the problem of combining individual liberty with the authority essential for social cohesion. Without some measure of pooled resources and central control, European civilization cannot survive, and that concentration can only be achieved by the creation of common loyalties and by a sense of common values.

This has already been recognized by the small nations, as was shown by the acting Norwegian Minister for Foreign Affairs, Mr. Trygve Lie, in a recent broadcast from London to the Norwegian people. Mr. Lie recognized that the alternative to the tyranny of the Nazi 'New Order' is co-operation with the free peoples, and his courageous and heartening words indicate that this co-operation is not limited in Norwegian eyes to the immediate purpose of victory and liberation; but implies "a state which must and shall endure after the war".

Such a declaration implies further responsibilities for Great Britain. The abandonment of a policy of isolation and neutrality can be neither negative nor unilateral. We must be prepared to play our part in this new conception of European order and to continue after the War the planned co-operation already begun under its exigencies. In consultation with those countries which now share with her the fortunes of war, Great Britain must at least lay the foundations of a new economic order which will take account of their interests as well as her own, and will enable their industries and their agriculture to flourish side by side with her own.

Something more than this, however, is involved in an effective reply to the Nazi policy and tyranny. It is not enough to develop by persuasion and negotiation a European federation or system of freer trade, stable rates of exchange and greater economic regions. The democratic order implies indeed an international association with certain machinery, for which the League of Nations provides precedents and lessons. It implies participation by all countries which believe in freedom rather than tyranny, in persuasion rather than force, so that there is sufficient good will to outweigh any possible ill will. But to work the new machinery a new spirit is wanted.

The admirable article in the *Round Table* derives its special value from its insistence on this point. The new order towards which the free peoples are groping can only be brought forth under the dynamic inspiration of a great ideal, and the formulation of this ideal is indeed an essential part of our war strategy if we are to meet the almost fanatical devotion which Hitler has inspired for their ideal in the German people. To the courage, endurance, self-sacrifice and faith of the nations which believe in justice and liberty there are indeed clouds of witnesses. Their ideals await expression in prophetic utterance.

We have not, as the *Round Table* reminds us, developed the outlook demanded by modern conditions. While science has abolished distance, unified the world, and made five continents adjacent countries, we are still inclined to retain the isolated, provincial minds of an age to which steam and electricity were unknown. The next stage in human progress is to discard the idea that self-preservation and national interest should be the only principles which determine foreign policy; and to believe that all nations, within the limits of their powers, have a duty to help actively to make justice, mercy and freedom prevail, and that the iniquity of the sufferings of other peoples are not merely their own concern but even a disgrace to the world. Only when that day dawns shall we have acquired a mind adequate to the conditions of modern civilization, and discovered an ideal more inspiring and effective than that offered by the Nazi regime.

AFRICAN SURVEY

Focus on Africa

By Richard Upjohn Light. (American Geographical Society, Special Publication, No. 25.) Pp. xv+228 +145 plates. (New York: American Geographical Society, 1941.) 5 dollars; 3 dollars to Fellows.

DR. LIGHT'S book presents us with a new technique in the methods of study travel in Africa—the use of the private aeroplane. Travel by motor-car has many obvious advantages for the student of African conditions, but is subject to two serious drawbacks. In eastern and equatorial Africa and some parts of West Africa, the traveller is confined during the rainy season to a few all-weather roads. Moreover, the great distances impose on him at all times an irritating waste of time. One is apt to forget, for example, that the area of French West Africa is greater than that of the Indian Empire; that the Belgian Congo is five times the size of France; or that the Union of South Africa, including its mandate, has four times the area of Germany. Here the aeroplane certainly has the advantage. But there is at present a very grave obstacle in the paucity of landing grounds and of metereological information, away from the main routes taken by commercial airways. Dr. Light's journey took him from the Cape, through the Rhodesias, Tanganyika, Kenya, Uganda and the Sudan, to Cairo. Air facilities are good in the Union, and fairly well developed in Southern Rhodesia; in Northern Rhodesia and East Africa they are very limited. It would have been interesting had Dr. Light's journey allowed him the opportunity of comparing conditions in the Belgian Congo, where the authorities appreciated, at an early date, the value of internal air communications, and have for a number of years maintained an efficient local service through the Sabena organization.

Dr. Light, unlike many of his predecessors in African air travel, has brought a trained scientific mind to bear on what he has seen in Africa. He is a physician who has devoted himself to the surgery of the brain and spinal cord. But he has also had a long experience of flying, in the course of which he has made a photographic reconnaissance of parts of the Rocky Mountains, and has completed a seaplane voyage round the world. This combination of man of science and competent airman must be rare. It is characteristic of the spirit in which he made this journey that, before setting out, he had (as his work indeed amply proves), made a very thorough study of the conditions of the territories he was to visit. His statements of fact are well documented, and the reader has the advantage of a well-selected bibliography of works on the current scientific and sociological problems of Africa. He had the good fortune to enlist the interest of the American Geographical Society of New York, and it was doubtless its generosity which enabled him to furnish the reader with maps on a far more liberal scale than most contemporary writers have found possible. There are no fewer than three hundred aerial photographs in this volume. They are of unusual excellence, and Dr. Light was indeed fortunate in having in the person of Mrs. Light a companion who was obviously so skilled in the use of the camera.

Dr. Light would no doubt himself agree that his book is of the character of a reconnaissance rather than of an attempt to make any original contribution to our knowledge of Africa. But it has a somewhat subtle merit of its own, and one which gives it a very real value. At the end of an attractive and pleasantly told narrative (including an interesting account of a visit to the game reserves on the Serengeti plains), the general reader will find himself in possession of a knowledge of African problems which he himself would scarcely have sought in specialist studies, and would not have found in the lighter type of travel book. Dr. Light comes nearest, perhaps, to an original contribution to our knowledge of Africa in his aerial studies of Kilimanjaro (where his photographs afford a useful supplement to those of the Swiss aeronaut, Walter Mittelholzer), the Ngorongoro crater (which still offers problems on which geologists hold conflicting views), and, above all, of the Ruwenzori massif. Cloud and rain conditions have always given this mountain an elusive character. Though the neighbouring territories had frequently been traversed before 1888 by competent observers, it was not until that year that Stanley and Stairs proved to an incredulous world the existence of its snow peaks. Its physical features have since become well known through Sella's wonderful photographs (taken during the Duke of Abruzzi's expedition), and the accounts given by Humphreys, Tilman and Shipton, and by the later Belgian and German parties. But aerial photographs are limited to those which Humphreys, after many disappointments, succeeded in taking in 1931. Dr. Light had also some disappointments, but it is fortunate that in the end a clear day permitted him to give us the excellent views which form Nos. 193–213 of his series. HAILEY.

CAMOUFLAGE IN WARFARE

The Art of Camouflage

By Lt.-Col. C. H. R. Chesney. With four Chapters by J. Huddlestone. Pp. 252+12 plates. (London: Robert Hale, Ltd., 1941.) 8*s.* 6*d.* net.

TO the evolutionary biologist, especially if he is a field naturalist with tropical experience, there are few subjects more fascinating than the camouflage devices of the animal kingdom. It is only recently that NATURE reviewed what must remain for many a day the greatest comprehensive work on this subject, H. B. Cott's "Adaptive Coloration in Animals" (NATURE, 146, 144; 1940). I had the advantage in my early days in the Gran Chaco of coming into very intimate contact with the subject both as a biologist and as one depending for his food on his success as a hunter. This experience incidentally drove home the fact, by no means generally appreciated, that there is a fundamental difference between the camouflage of small animals and of large. In the former, such as insects or small lizards, the dominating principle is that of imitative colouring to resemble the background or surroundings and in this group occur by far the most perfect examples of animal camouflage. The most common of Nature's backgrounds—the chlorophyll green of vegetation—finds an astonishingly perfect match in many animals—for example leaf insects or tree frogs or certain parakeets. Even within the limits of the group of parrots the imitative coloration is no longer found in the larger representatives, such as macaws or cockatoos. Among the larger animals in general it is absent, even where green vegetation forms the normal background.

The explanation of this curious fact is that the obliterative effect of imitative colouring becomes in a larger animal overborne by the effect of light and shade in showing up the modelling or relief of the body, precisely as an artist would depict it by the shading of his pencil or pastel drawing. To secure effective camouflage, Nature simply obliterates these differences in shade: the high lights on the back by dark pigment; the shadow underneath by white; and between these two extremes by compensative or counter-shading so as to cancel out exactly the differences in intensity of illumination. This counter-shading is the basic factor in the camouflage of many wild creatures in which the bulging relief of the body, so conspicuous in an ordinary domesticated animal, seems entirely flattened out.

Apart from its relief, the nature of a large object is commonly recognizable from its forming a continuous patch of colour or tone bounded by a characteristic outline. This is effectively counteracted in certain animals by a method totally different from counter-shading, namely, the so-called 'dazzle', in which the body bears a pattern of violently contrasting tones, such as the black and pale yellow of the zebra or jaguar. The functions of this 'dazzle' are two, namely, (1) disruptive, in that it breaks up the apparent continuity of surface and outline, and (2) distractive, in that its violent pattern grips the attention so that the fleeting glance fails to call up the mental picture of the particular animal.

It was when present at the opening of the Kiel Canal in 1895 that the sight of the obliteratively coloured warships of Germany and France in their uniform 'battleship grey' led me to realize the extent to which man in his war camouflage falls short of what is attained by Nature in the animal kingdom. The effect of the grey coloration was obviously interfered with by differences in light and shade, which detracted from the obliterative effect not merely of the ship as a whole but still more so in the case of those details which on one hand betray the character of the ship and on the other hand, through their perspective, play an important part in showing how the ship is heading. No attempt had been made to counteract those disturbing effects by the application of counter-shading; nor had any attempt been made to obscure the form of the ships or of their details by destroying the obvious continuity of their surface and outlines by the employment of 'dazzle'.

It was this experience at Kiel, superimposed on the earlier experiences in South America, that led to my taking up seriously the subject of war camouflage and suggesting—apparently for the first time—that war camouflage, so far as camouflage by means of paint is concerned, must, to secure full effectiveness, be in accord with those principles, (1) counter-shading and (2) 'dazzle', to which is due the effectiveness of camouflage in the larger animals. These suggestions were communicated to the Admiralty and War Office during the War of 1914–18 and simple instructions as to carrying them into effect were promulgated to the Fleet in November 1914 and will be found reprinted in the *Nautical Magazine* of July 1940. The soundness of these general principles must be borne in mind by anyone criticizing either the carrying out of camouflage in practice or its literary exposition.

Lieut.-Colonel Chesney has produced a readable volume on the art of camouflage. Its contents are in some respects of an unexpected nature. The introductory section by J. Huddlestone deals with various general considerations (in which it is pleasant to note the tacit admission of the part played by the coloration of animals in providing the foundations for the subject). This section of some forty pages is followed by one of seventy-two entitled "Material Camouflage", and this in turn by the concluding section of some eighty pages devoted unexpectedly to "Strategic Camouflage"—the camouflage of military intention—including chapters on Napoleon, Stonewall Jackson, the Boer War, and the War of 1914–18.

Though the whole book is thoroughly readable, it is the section entitled "Material Camouflage" which will attract the ordinary reader desirous of obtaining information about war camouflage in the ordinary sense. For camouflage in Nature he will turn to the great work by Cott: for strategic camouflage he will consult the military historian. Parts of this section are excellent, more especially those parts which deal with the author's own valuable work during the War of 1914–18. In introducing his story of camouflage during that war, the author remarks that "camouflage in practice is not so much a matter of making dream pictures as of organization and practical adaptation of materials". There is much truth in this statement, which expresses quite fairly the attitude of those responsible for camouflage work during the former war. Its fault and theirs lay in the apparent unawareness of the teachings of Nature and her demonstration of the overwhelming importance of the principles of counter-shading and dazzle. In stressing the importance of organization it seems strange that there is no mention of Mr. Norman Wilkinson, who did so much in the way of organizing the large-scale application of dazzle to ships during the later stages of the War. This is not the only strange omission in Colonel Chesney's book: I find nowhere any mention of Dr. Hugh Cott, to whom the country owes the first demonstration—within the last year—of the marvellous potentialities of counter-shading when carried out under the supervision of a scientific expert.

The really valuable kernel of the book is to be found in the latter part of Chapter v, with its most interesting account of the use of net camouflage; in Chapter vi on civil camouflage; and in Chapter vii on military camouflage in the future. These are well worth perusal: they put clearly and effectively many considerations of importance which, embodied in an attractive popular work, may perhaps gain more attention from the powers-that-be than when urged privately by the scientific specialist. Such points are the importance of developing the use of smoke screens on land, the use of black paint, the reduction in height of hangars and other buildings, the use of growing trees (but the absurdity of merely painting trees upon the walls of an edifice), and the dispersal of accommodation in a number of small buildings irregularly sited.

The author is sceptical about the efficacy of ship camouflage, but it should be borne in mind that in the War of 1914–18 this was restricted to dazzle, without the necessary scientific supervision and unaided by counter-shading, and that even with these imperfections it was regarded as of distinct use by the mercantile marine and by hard-headed underwriters.

When a new edition is called for, no doubt the author will correct obvious slips and misspellings such as Kallina, Portorus and Sir A. J. Thompson; and he should really look up the history of the word 'camouflage'. JOHN GRAHAM KERR.

INTENSIFICATION OF BRITISH AGRICULTURE

The New Farming: Continuous Cropping by the Wibberley System
By Tom Wibberley. Pp. v+171. (London: C. Arthur Pearson, Ltd., 1941.) 8*s*. 6*d*. net.

DURING the War of 1914–18, the late T. Wibberley published his book "Farming on Factory Lines", in which he advocated more continuous systems of cropping than those generally in use. It was an interesting book, well written, showing on every page the writer's forceful personality; it certainly induced a number of people to examine the proposals even if they were not persuaded to adopt them. Much of the material had been collected while he was in Limerick as agricultural instructor, and later when he was appointed professor of agriculture at University College, Cork, the chair having been specially founded by the late Howard Harrington, who was attracted by the possibilities offered by the system.

Now in this War his son, also T. Wibberley, has revised and reissued the book in the hope that it may prove of value both in the present conditions and in the new ones that will arise when the War is ended. Under the old four-course rotation the arable land is cropped for about 38–40 months out of the 48, and is left bare or in stubble for the remaining eight to ten: broadly speaking for the space of two winters. During each of these it is very desirable that the land should be ploughed and exposed to the frost so that the soil may build itself into the crumb structure so necessary for securing a good seed bed. If the winters are dry and frosty all goes well, but often they are wet and mild and the soil becomes sticky and loses valuable nitrates by leaching. The essence of the "factory lines" methods is to grow crops during these months, so avoiding the loss of nitrate and adding to the total quantity of produce on the farm. The insertion of catch crops is an old device, and has been much practised by the arable sheep farmers on the South Downs and by other groups of farmers, but there were sufficient distinctive features about the Wibberley methods to justify some claim for novelty.

The methods were tested in Ireland and were said to give satisfactory results. In England, on the other hand, catch cropping and continuous cropping have never come into general use on any extensive scale. Autumn-sown crops make but little growth during winter in the drier arable regions of the east, and on the other hand sufficient time must be allowed for cultivation to kill weeds. Attempts at full time cropping have not usually succeeded in these regions, nor did they on Sir E. D. Simon's farm at Leadon Court, Herefordshire, although one readily agrees that if it could be done the results might be valuable. The author's statement on p. 52 that his father in one year turned out beef and mutton to the value of £5,188 14s. 7d., with a total expenditure of £81 2s. 2d. on purchased cakes and meals must make many farmers' mouths water, especially when one is told that this was largely done with tares and winter green crops. The farmers' reaction would almost certainly be: if this young man was brought up to such a lucrative system of farming, why did he ever leave it?

The old four-course rotation has been much altered in its details, and wherever possible it is certain that farmers will grow catch crops, and increase their output of fodder in every way possible. What, however, is needed in regard to the present proposals is not more writing or propaganda about them, but to put them into practice on some actual farm so that other farmers can see what they are like in operation. If the author could bring this about he would soon be able to show whether the returns justify the labour and money involved. E. J. RUSSELL.

The Moral Paradox of Peace and War

Conway Memorial Lecture delivered at Conway Hall, Red Lion Square, W.C.1, on March 23, 1941. By Prof. J. C. Flugel. Pp. xi + 52. (London: Watts and Co., Ltd., 1941.) Paper, 1*s*. net; cloth, 2*s*. net.

IN his highly suggestive and constructive Conway Memorial Lecture, "The Moral Paradox of Peace and War", Prof. J. C. Flugel gives us an acute analysis which is as pertinent to our plans for reconstruction as to the building of a world order from which war has been eliminated. Starting with an analysis of the moral qualities which are responsible for the real challenge of war and which have already led to a certain recognition of the need for a moral equivalent of war, he indicates concisely the points at which this challenge must be met in a progressive society in which full expression is given to legitimate desires and aspirations. Notably he stresses the spirit of adventure, with all it connotes of excitement, uncertainty, danger and tenseness or strenuous endeavour. Of this, as well as the social solidarity, the heightened sense of the individual being needed, and the identification with a nobler cause for which he or she is prepared to make any sacrifice, any stable order must take account of, and must seek to satisfy by discovering, a common purpose comparable in intensity with that induced by war. The great task that confronts democracy is to find a formula for integration in harmony with its own essential spirit, which will express our fundamental agreement as to the ultimate goal while preserving our present liberty of thought and discussion as to the best means of attaining this goal. As Prof. Flugel sees it—and in this most scientific workers will concur—we must learn to face the stark realities of man's place in Nature, and find in the challenge and opportunity they afford for the exercise of human genius, combativeness, courage and co-operation, the true moral equivalent of war. R. B.

Aids to Inorganic Chemistry

By R. G. Austin. Pp. x+348. (London: Baillière, Tindall and Cox, 1940.) 5*s*.

THIS small volume is not intended as a complete text-book of inorganic chemistry, but is designed to give students, who have already attended lectures on the subject, a condensed survey of the principal facts. The subject-matter covers the course required by students of pharmacy, medicine, dental and veterinary surgery.

The preliminary chapters are rightly devoted to general topics such as the atomic theory, acids, bases, salts and the periodic classification. Unlike the non-metals, the metals are considered in the same sequence as they occur in the periodic table, and this has enabled the author to stress their family relationships. The medical aspects of chemistry have been emphasized wherever possible, and the reader will find the notes on the physiological action of common inorganic substances both interesting and profitable.

The author states in the preface that "simple interpretations of the mechanism of chemical reactions have been given prominence in order that students may gain some insight into the principles of chemical change"; it is therefore surprising to find that the ionic aspect of inorganic reactions has been almost totally neglected. In spite of this omission, students of medicine and allied subjects, in search of a book containing a wealth of concise factual matter, should find the book a useful aid to their studies.

A. C. C.

This Living World

A College Course in Science. By Prof. C. C. Clark and R. H. Hall. Pp. x+519. (New York and London: McGraw-Hill Book Co., Inc., 1940.) 22*s*. 6*d*.

THIS well-written and well-illustrated book can be recommended especially to those teachers in training who expect to teach general biology in primary or secondary schools. It displays an unusually expanded breadth of vision, thus covering all aspects of life and living. Though the book will not satisfy the needs of the student of biology, from the point of view of examinations, it would well form a supplement to his more academic reading.

In a form which combines accuracy with pleasant reading, the book presents the gist of modern knowledge about the living world, with special reference to the physical development of man and the structure and functioning of his body. Thus it is of cultural as well as simply academic value.

Radioactivité et transmutation des atomes

Par Dr Théodore Kahan. (Collection Armand Colin: Section de physique, No. 222.) Pp. 224. (Paris: Armand Colin, 1940.) 15 francs.

DR. KAHAN'S stimulating account of the more recent developments in radioactivity and the artificial transmutation of the elements will be welcomed by all students who require a short up-to-date survey of the subject. It gives a very satisfactory account of the state of our knowledge of α-, β- and γ-ray spectra which is easily followed, and also gives a discussion of the energetics of nuclear changes which is particularly clear and helpful. His treatment of nuclear reactions such as (α, p), (α, n), etc. covers all the more important aspects in a remarkably concise way. The reviewer hopes that this little volume may still be obtainable in Great Britain.

L. F. B.

The Study of the Soil in the Field

By G. R. Clarke. Third edition. Pp. 228. (London: Oxford University Press, 1941.) 6*s*. 6*d*. net.

THE third edition of this valuable little handbook of soil survey differs from the second edition only in having an appendix in the form of the instructions to surveyors, accepted by the Soil Survey Conference of Great Britain. This should add considerably to its practical utility. The author states that the time is inappropriate for a revision of the text; nevertheless it is to be regretted that, since the book is apparently (and deservedly) becoming a standard work on soil survey, the opportunity was not taken to remedy some inconsistencies in literary composition and the misuse of abbreviations which have been freely invented by the author and employed often without explanation, leaving their meaning to be guessed by the reader.

EVOLUTION OF FUNCTION IN THE MAMMALIAN ORGANISM*

BY SIR JOSEPH BARCROFT, C.B.E., F.R.S.

THE life of the mammal is a synthesis of many diverse functions. They range from the digestion of porridge to the performance of Brahms, from snoring to the niceties of mathematical analysis. Here I am concerned neither with the higher faculties of the mind nor with the lower vegetative functions of the body; but merely with that intermediate region of activity which concerns itself with the muscular movements—getting about and the like—these we share with our mammalian relations generally.

A child, for example, learns to walk. It is, so far as locomotion on its legs is concerned, capable of one kind of movement—crude, uncertain toddling. From that movement, however, quite a number of things develop, the initial ability to toddle turns unconsciously into the power either to walk or to run, and these more refined movements, when exploited by conscious intelligence, create the possibility of anything from tap dancing to tight-rope walking.

But instead of interesting ourselves in the variety and complexity of the movements into which toddling may develop, we may look the other way. We may ask: Can it not be that toddling, itself a highly complicated affair, is not a development or differentiation of some much cruder form of movement, and, if so, what is that movement and is it the parent of movements other than toddling, just as toddling is the parent of tap dancing and mastery of the tight rope? By way of parenthesis the words "just as" require a caveat. We ordinarily regard the development of walking from toddling as a question of practice. Can the same be said of intra-uterine movements?

These are the questions which I wish to attack:

(1) What is the most primitive form of movement of which the mammal is capable?

(2) Does this movement differentiate and develop into other and more complicated ones?

(3) If so, are they recognizable as the forerunners of the sorts of movement with which we are ordinarily familiar in life?

Studies of the earliest movements of which the mammal is capable have been made by a number of observers, mostly on small animals with short periods of gestation, and from several points of view.

The sheep, for example, has the advantage over small animals in that development in it is a comparatively leisurely affair and its steps are therefore easily recognizable. To quote Barron, "All the events which take place over two months in the sheep are telescoped into a single week by the rat."

The period of gestation in the sheep is twenty-one weeks—147 days; until the thirty-third day of embryonic life, the organism is not capable of any inherent movement apart from the beating of the heart. At this age it is about the length of the thumb nail and it has taken on the general mammalian form. Its eyes are well developed, its trunk, tail, fore-legs and hind-legs are all there, though in a rudimentary way. The fœtus at this age does not move except in response to a, for it, rather considerable stimulus. This stimulus is quite specific, it must be given in just the right place and the response is perfectly definite. Tap it firmly just under the eye and it will give a twist to its neck. This twist causes the head in the first place to go back, and in the second place to rotate, drawing its nose towards the point of the glass rod, or what not, with which it was tapped. Tapping no other place will elicit a movement.

Why, you may ask, is this particular point on the cheek so different from the rest of the body that a response can be elicited from it and from it alone? There is a very good reason. Here, just beneath the skin, is the end of a nerve. It is the fifth cranial nerve or, rather, a branch of it. It grows down from the brain and will ultimately supply the upper jaw and the nose with sensory fibres. This is the nerve which will impress itself on one's consciousness if one gets a spasm of toothache in the upper jaw or if one smells ammonia. It is perhaps worth noting that regionally it is the nerve which supplies the most anterior part of the body.

In case a sheep were to walk forward (the natural direction of progression) the first bit of it to run into an obstacle would be the tip of its nose, and the nerve which supplies the tip of the nose is the first sensory nerve to give a response. But by the thirty-third day the fibres of the nerve have not yet reached their destination, they have only reached the point under discussion. The reason why the face must be tapped rather sharply is because the immature endings of the nerve are definitely underneath the skin and not in it. The stimulus must be transmitted through the skin to the deeper structure.

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* Substance of a lecture delivered at the Royal Institution on May 20. The lecture was in effect a description of a film illustrating the work of the lecturer in collaboration with Dr. D. H. Barron. Its format was dictated by that fact, especially as regards absence of documentation. Its documentation and its setting in relation to the work of other observers will be found in Dr. Barron's article "The Functional Development of some Mammalian Neuromuscular Mechanisms" (*Biol. Rev.*, 16, 1: 1941).

The nature of the movement is reflex, that is, it is caused by a peripheral stimulus, which is transmitted to the central nervous system, in this case, the brain, which passes thence to the motor nerve that supplies the neck muscle concerned. That the first movement should be a reflex, or even a movement which involves the nervous system, is not true of all forms of life. Seemingly there is a tendency in the higher forms for neurogenetic movement to appear earlier relatively to myogenic, until, as in the sheep, movements involving the nervous system occur as soon as, or even before, those of a purely muscular character.

So much for the very first movement. In the few days which follow, the principal alteration which occurs is an expansion of that. This expansion takes place in at least four different directions.

(1) The area of skin on the face, the stimulation of which will elicit the movement, becomes greater. Other branches of the fifth cranial nerve, the great sensory nerve of the face, develop, and as they do so the areas of skin which the nerve has reached become sensitive when stimulated and evoke the movement.

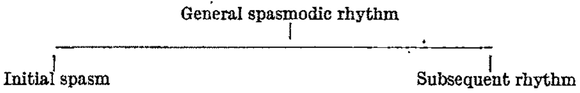
(2) The movement itself embraces an ever-increasing number of muscles, so that instead of being confined to the neck, it spreads within the next week or so to the mouth, the trunk muscles, the limbs and the tail, so that the movement amounts, not to a twitch of the neck, but to a trifling convulsion of most of the body.

(3) More than this, the response extends not merely in the number of muscles which are involved, but it also extends in respect of time. Stimulation causes not merely one spasm but a series of perhaps twenty spasms, one after the other, amounting to a rhythm.

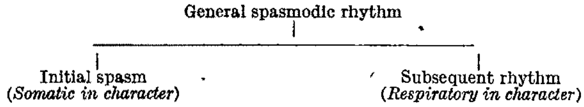
(4) A much less vigorous stimulus will suffice, as it were, to touch off the trigger of this mechanism—a drop of saline on the eye, the direction of a current of fluid into the nose or even a sharp tap on the outside of the sac within which the fœtus floats in its bath of amniotic fluid.

Up to the forty-second day (approximately) the fœtus has exhibited only one kind of movement, the spasm. This may have been more or less widespread, it may have been repeated more or less often, but fundamentally there was but one essential pattern.

Now, however, something quite new is seen. If the fœtus be stimulated, say by a tap on the nose, a rhythm of spasms follows, but the first or first two members of the rhythm differ from the subsequent ones. In the first spasm, the head is thrown back, in the subsequent ones it nods forwards. This is the commencement of differentiation of movement—for slight as is the difference between the initial and the subsequent spasms, that difference develops into something abundantly evident and of great importance. We have then :



To appreciate what has taken place, we have only to pass on a few days. The trifling difference between the initial and subsequent members of the rhythm is seen to denote a definite splitting of function. The initial spasm is shaping towards an indefinite body movement in which the limbs are largely represented whilst the subsequent rhythm affects principally those muscles which are ultimately concerned with respiration. The initial movement gives one the impression that the fœtus is trying to do something; though it is not at all clear what this 'something' may be, the subsequent rhythm gives the impression of the fœtus having been mildly out of breath as the result.



By the forty-eighth or forty-ninth day there is an obvious development of both the somatic and respiratory movements, though in rather different ways. The somatic movement becomes more purposeful in character, the respiratory movement becomes more regulated. Take these movements one by one.

One new element which enters into the somatic movement is gravitational response. When the fœtus is lying on its side, stimulation of the nose causes a twisting of the neck and body, the effect of which is to turn the crown of the head upwards towards the sky. This reaction to gravity is different in some respects from that with which we are familiar in the mature organism. In the latter the semi-circular canals play an active part, but all observers agree that this is not so in the fœtus, or rather in the fœtus at forty-eight days; the response is of a different nature. It is due to the unequal pressure on the two sides of the trunk and perhaps elsewhere. The side on which the fœtus is lying naturally bears its weight, and it seems to be the fact that the pressure on this side is the stimulus to the gravitational response. This may not be the whole stimulus, but whether it is or not, if a piece of cardboard be placed firmly on the upper side of the body so that both sides are pressed upon, the gravitational response disappears.

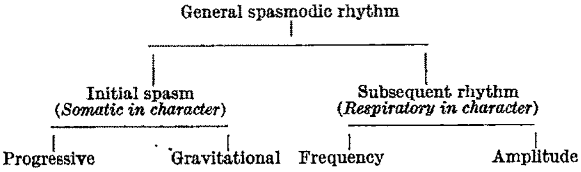
As regards the limb movements : those of the fore-limbs are not symmetrical either. Both are stretched forwards as far as the knee, but whereas the uppermost fore-leg is stretched right out, all the joints being extended, with the lower fore-limb it is different ; it is flexed at the knee and the toe is pointed backwards.

The whole movement in a crude way seems to be an effort on the part of the fœtus to rise from the ground, in just the way which it does shortly after birth. The hind-legs are gathered up underneath the belly of the fœtus. If, then, we may stretch the word progression to include rising from the ground, we may regard the movements seen on the forty-eighth day as containing the germ of progressive movement.

As regards the respiratory type of movement* on the forty-eighth–forty-ninth day, two alterations are taking place.

(1) The first is that the respiratory rhythm becomes daily more easy to evoke. By the forty-ninth day almost any muscular movement of the fœtus, however trifling, will touch off a respiratory rhythm ; indeed, if at this time the observer lays the fœtus in his hand it is scarcely possible to hold it sufficiently still to prevent stray alterations of tension in the muscles from evoking some response.

(2) The second advance in the evolution of function is the gradation of the respiratory rhythm to correspond with the force of the muscular movement which preceded it. Thus, if the fœtus be held very still, the respiratory responses due to adventitious movements will be relatively slow and shallow, but if the fœtus be given a sharp tap so that it makes a dramatic effort, that effort is followed by a rhythm which is not only more rapid but is also more powerful. We therefore have reached the following position.

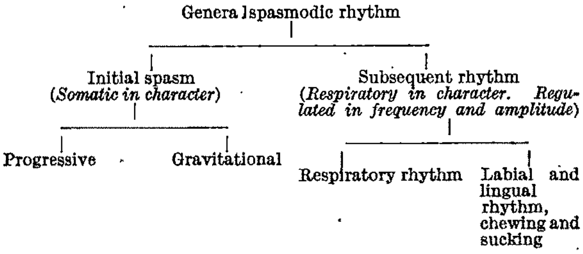


Somewhere about the seventieth day, the movements of the mouth are very prominent. If an object be placed inside the buccal cavity, powerful rhythmic movements are often seen. These resemble both chewing and sucking ; it is not quite accurate at this stage to describe them as either, nor is their relation to other movements clear. In this matter, as in many others, we have been helped by the following fact : on exposure or mild asphyxiation of the fœtus, its movements change ; those functions of the brain which have been developed most recently are first affected, and therefore as the fœtus during the progress of this experiment deteriorates in vitality, its movements tend to resemble those which it made at an earlier stage of fœtal life. A seventy-day fœtus as it deteriorates will tend in its type of movement shortly to behave like a sixty-day fœtus, then like a fifty-day one, and so on.

In such deteriorating embryos, it may be seen that the rhythmic mouth movements which at seventy days appear to be quite distinct from any others, gradually merge into the general respiratory, from which they have no doubt been differentiated.

I have spoken a great deal about the fifth cranial nerve, and I would end this part of my lecture by collecting some of the points which I have stated about it. The earliest reaction which it gave me was local ; as the fœtus grew, the reaction became widespread, but by the seventieth day it has become strictly localized again. I emphasize this sequence because, though exhibited in its most striking form by the fifth cranial nerve, it is true of all sensory nerves, the reaction to stimulation of them being, initially, local, becoming more widespread but finally settling to a local response.

The following chart sums up, so far as we can go here, the information at our disposal about the differentiation of actions of various sorts :



CHARACTER OF MOVEMENT

Hitherto I have spoken of the evolution of a number of actions, if I may describe them by that term, breathing, chewing, getting up and the like. But any of these actions may change in character ; it may be rapid, jerky and spasmodic, or it may be drawn out and gradual, or, again, it may even be a sustained movement in which there is an actual static phase, such as the Nazi salute. The evolution of the actions which I have described has all concerned itself with those parts of the central nervous system into which sensory nerves enter and from which motor nerves leave—the hindermost part of the brain (the medulla) and the spinal cord. In general, the organization of action takes place from above downwards, and it is initiated at the point of entry of the nerve which receives sensations from the face and nose and is modified later by influences entering the spinal cord from the arms, the trunk and the legs. But if in the central nervous system this evolution of function takes place from the point of entry of the facial nerve backwards, it takes place in a different sense from that same point progressively forwards. The forward development is concerned less with what the fœtus does, than with how he does it.

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* It must not be supposed that these movements cause anything to go into or out of the chest at this age. The windpipe is not open, and owing to the softness of the chest wall no measurable negative intra-thoracic pressure is induced by the rhythmic movements of the diaphragm, the intercostal muscles and the throat muscles.

The first movement of all was a simple twitch or a minute spasm; when later it became necessary to expand this twitch into something which stretched over a longer time, the expansion consisted of the extension of a single twitch into a series of twitches—a rhythm, but the character of each individual jerk of which the rhythm consisted was unaltered; even when differentiation commenced the twitches were still twitches.

Between the forty-fifth and fiftieth days, however, the movements gradually assume a different character, namely, they take on an air of deliberation; if the arm is thrust out, the movement is less that of the boxer getting in his punch than that of the constable raising his hand to stop the traffic.

Just as the jerky movements obtained from the lower parts of the central nervous system gradually took on a certain appearance of purposefulness and became evidently the forerunners of the types of movement which we actually recognize, so these sustained movements also tend to fall into certain patterns which we recognize as postural. In association with the turning of the neck to which I have already alluded, there are harnessed the corresponding movements of the legs, that is, the fore-leg on the side to which the nose is turned is extended, whilst the other fore-leg tends to be flexed or partially so. At a later date, characteristic postural movements of the hind-legs, the trunk and the eyes are associated with this twisting of the neck. Indeed, it is only necessary to take the head between one's fingers and rotate the neck alternately in one direction and then in the other to produce this corresponding marionette-like movement of the eyes and limbs.

These postural movements are essentially those described by Magnus and de Klejn; the difference between their demonstration of the movements on the adult animal and our own on the fœtus is that they, in order to secure the movements, had to perform a surgical operation in which the mid-brain was relieved of the influence which dominated it, notably the semi-circular canals. In the case of the fifty-five day sheep's fœtus, no such surgical operation is necessary because what Magnus and de Klejn cut away has not at this age functionally developed. The alteration from the simple jerky type of movement to the more deliberate postural type is attributable to this development of the mid-brain and its influence on the centres below it.

The initial phase of postural movement soon disappears; by the sixtieth day, if the fœtus be delivered, it exhibits a different picture, the fore-legs are tensely stretched out side by side, the head and the tail are extended, and the fœtus presents the appearance of an animal suffering from what is known as 'decerebrate rigidity'—a condition which, again, can only be obtained in the adult by a surgical operation, that of severing the foremost parts of the brain from parts behind them, and so ridding these latter from the influence of the higher centres. But once more, in the case of the sixty-day fœtus, no surgical operation is necessary for the simple reason that the higher centres in question have not developed physiologically—function has developed upwards far enough, but only far enough to produce this rigidity.

The picture of rigidity does not last many days. From about the fiftieth day onwards a characteristic has been gradually creeping into the picture, slight at first, but quite evident; by the seventieth day it becomes dominant, namely 'inhibition'. During the eighth and ninth weeks, this growing inhibition amounts to no more than a certain evident restriction of movement associated with the postural patterns which I have described. On the seventieth day, however, if the fœtus be delivered, so far from exhibiting spasmodical or postural movements, it gives the impression of being dead or at all events soundly asleep. If mechanically stimulated, the stimulus must be strong if it is to be effective, and even at that the response is only very restricted. This suppression of movement means that function has progressed well up into the fore brain. That motility has not been abolished but only suppressed is easily proved. It is only necessary to leave the fœtus exposed for a while or to pinch the umbilical cord in order to uncover the functions which I have tried to describe. A more elegant proof is furnished by intra-uterine transection of the central nervous system. It is possible to cut across the brain or cord at any given point, between the fiftieth and seventieth days, without impairing the growth of the fœtus. If, at seventy days, the section consists in mere severance of the cerebral hemispheres from the rest of the central nervous system, no change in the behaviour of the fœtus can be seen, but if the section is lower down—about the middle of the fore brain—the lower parts are freed from 'inhibition' and the fœtus exhibits the 'rigidity' pattern of sixty days. If the section is just below the 'pons Varolii', the fœtus exhibits almost unceasing jerky movements, which are both somatic and respiratory and are strongly reminiscent of a fœtus of about forty–fifty days. At seventy days, however, the fœtus appears to be in a sound sleep and in this sleep we may leave it.

MYOSIN BIREFRINGENCE AND ADENYLPYROPHOSPHATE

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OUR knowledge of the nature of muscular motion has hitherto been divided into two main fields of successful analysis. First there was the discovery of the phosphorylation cycles whereby energy is transferred from carbohydrate breakdown to the muscle fibre; here the earliest landmarks were the investigations of Fletcher and Hopkins[1] and of Harden and Young[2] (see the papers of Parnas[3] and D. M. Needham[4] for up-to-date reviews). Secondly, there was the discovery of the elongated or anisometric character of the particles of muscle-globulin (myosin), demonstrated in the classical paper of v. Muralt and Edsall[5], leading to the application of X-ray techniques to the problem, and the establishment by Astbury[6,7], that muscular contractility is essentially a molecular contractility of protein chains. The exact connexion between these two orders of fact, however, still remains obscure.

In order to bridge this gap, the most promising point of departure seemed to be the important finding of Engelhardt and Ljubimova[8] in 1939 that the enzyme adenylpyrophosphatase is either myosin itself or some protein very closely associated with it. This was confirmed by one of us (D. M. N.) in the following year (unpublished) and recently by Szent-Györgyi and Banga[9]. Its importance lies in the facts: (1) that the breakdown of adenylpyrophosphate is, among the processes of intermediary metabolism in the muscle, that nearest in time to the contraction of the fibrils, and (2) that although some adenylpyrophosphate is broken down by transfer of phosphate to hexosemonophosphate (by an enzyme not present in the myosin fraction), the quantitatively largest part of its breakdown probably occurs by splitting off of free phosphate under the influence of the enzyme adenylpyrophosphatase. It was thought of interest, therefore, to study the effect of adenylpyrophosphate upon the flow birefringence of myosin. The myosin sols were contained in a small annular cell holding just less than 1 c.c., mounted on the fixed stage of a Swift-Dick polarizing microscope, and having the outer co-axial cylinder driven at speeds variable up to 500 rev./min. (shear-rate 4·08 cm./cm./radian). Myosin preparations were also examined at higher dilutions in the co-axial viscosimeter referred to in a recent communication in NATURE by Lawrence, Needham and Shen[10] (shear-rates of 0·73 and 4·2 cm./cm./radian according to the diameter of the inner cylinder used).

Myosin preparations showing strong flow birefringence (Δ 50–80°; Ψ 50–60° for 1–2 per cent sols at 20° C.) were obtained from rabbit muscle by the usual method. Until this year, myosin sols prepared in Cambridge had nearly always been non-birefringent, and although the reason for this is being made the subject of a special study by Dr. K. Bailey, it may be said here that, provided the rabbit has been starved for twenty-four hours before death, the myosin never fails to show flow birefringence*. In the light of observations such as those reported below on the viscosimetry of myosin, it is likely that these differences are simply due to the size and shape which myosin particles assume when extracted from muscle cells under different conditions. Some preparations of myosin, however, which do not show flow birefringence, may show anomalous flow at low shear-rates, and are then analogous to the preparations of globulin from amphibian embryos described by Lawrence, Needham and Shen[10].

If now a myosin sol containing about 3 per cent of the protein is mixed with adenylpyrophosphate at pH 7·0, a considerable decrease in the flow birefringence intensity is immediately observed, for example, 65°–45° (see Fig. 1). This fall occurs in less than a minute at room temperature, but at 0° C. is so lengthened as to allow of its being plotted on a curve. With adenylic acid or inorganic pyrophosphate, the fall is either absent or slight. An important feature of the effect is that it is reversible; after it has occurred, the flow birefringence intensity of the sol rises, reaching its original level in about 2 hr. at 37° C. or overnight at room temperature, and then rising beyond it. It may be added that strict control of the salt concentration is essential, since if increasing amounts of solid potassium chloride are added to a white, almost salt-free, gel of myosin, the flow birefringence intensity continually decreases to reach a minimum at molar concentration, when the sol so formed is most transparent. After that point, with increasing amounts of the salt, the flow birefringence intensity increases, apparently because of the increasing amounts of transparent gel formed by salting-out. Hence in the above-mentioned experiments the ionic strength of the adenylpyrophosphate or other substances added was compensated for in such a way as to bring all samples to a final concentration equivalent to the ionic strength of 0·75 *M*KCl. In order to avoid the effects described by Edsall and Mehl[11], potassium was the only cation present. Finally, viscosimetric measurements indicate that the relative viscosity decreases, but not the anomaly of flow (see Fig. 2*a*).

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* The suggestion that the state of nutrition might be a factor was due to Dr. H. Lehmann.

Interpreting the effect, we consider that the first change is a moderate shortening of the myosin particles, with or without a certain amount of disaggregation. This seems not quite analogous with the changes produced by increasing potassium chloride concentrations below molar, for here, although the flow birefringence intensity also falls, and correspondingly the relative viscosity, the anomaly of flow decreases and eventually disappears. Hence the particles must become drastically shorter as well as possibly smaller. After the molar point is passed, though flow birefringence and relative viscosity increase, the viscous anomaly does not again become observable, probably because although the particles lengthen, their axial ratio decreases owing to some form of aggregation. In all such explanations we provisionally ignore the role of intermicellar forces (*cf.* Langmuir[12]) which may well be of importance in the relatively dilute solutions we have used, and must almost certainly be so in more concentrated mixtures such as occur in the muscle fibril itself.

The subsequent rise in flow birefringence intensity during the action of the enzyme, however, is more difficult to interpret, since that of myosin sols in potassium chloride alone will, if placed at 37° C., steadily increase until they set to a thixotropic gel. We have frequently observed in this respect what may be a protective action of adenylpyrophosphate, the sol returning to approximately its original birefringence intensity, and then remaining there for some hours, only in the end to rise. In such circumstances, the parallel increases in relative viscosity and viscous anomaly are also inhibited. This effect on the particle shape recalls the protective effect of adenylpyrophosphate on the enzymic activity itself at 37° C. discovered by Engelhardt and Ljubimova[8], and confirmed by us.

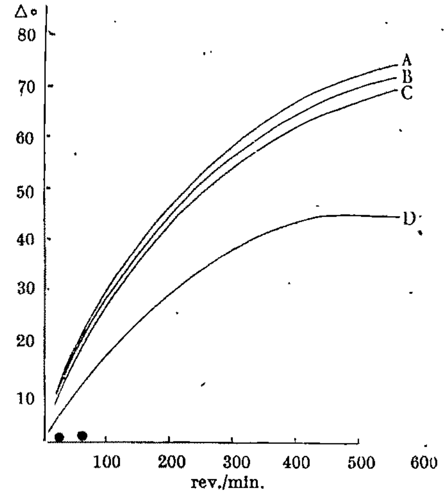

Fig. 1.

REDUCTION OF FLOW BIREFRINGENCE OF MYOSIN BY ADENYLPYROPHOSPHATE.

A, POTASSIUM ADENYLATE; *B*, CONTROL; *C*, POTASSIUM PYROPHOSPHATE; *D*, POTASSIUM ADENYLPYROPHOSPHATE.

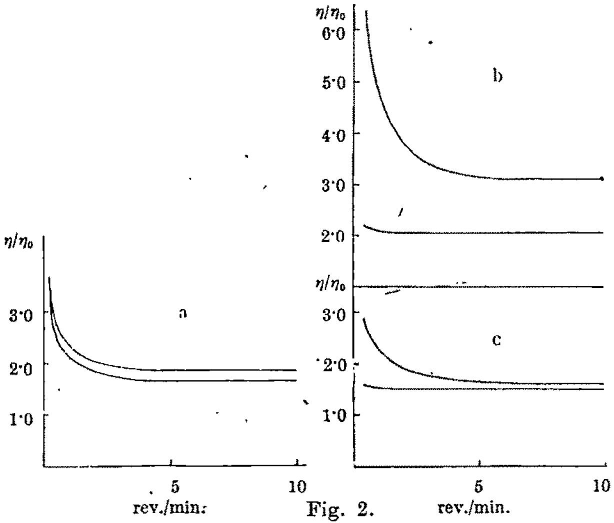

Fig. 2.

VISCOSITY OF MYOSIN.

(*a*) EFFECT OF POTASSIUM ADENYLPYROPHOSPHATE; (*b*) INCREASE OF ANOMALOUS VISCOSITY IN A DILUTE BIREFRINGENT MYOSIN KCl SOL HELD AT 37° C. FOR 2 HR.; (*c*) RESTORATION OF ANOMALOUS VISCOSITY TO A NON-BIREFRINGENT MYOSIN KCl SOL BY TREATMENT AT 37° C. FOR 2 HR.

The reversibility of the change in flow birefringence intensity of myosin is of much interest, since according to Edsall and Mehl[11], no treatment has ever hitherto been found to restore flow birefringence when this property has once been lost. We find, however, that adenylpyrophosphate is not unique in causing a reversible fall in flow birefringence intensity. After the flow birefringence has been reduced or abolished by ions such as Li', Ca'', Mg'', or NH_4', or by urea, all that is required to restore it is a short period at physiological temperature (or under some conditions even at room temperature), and its original value is reached long before any signs of gelation appear. It is even possible in this way to restore flow birefringence to a myosin sol which on long standing at 0° C. has lost the property. During such a restoration, or during the rise of birefringence from its original value in, for example, a 0·5 *M* KCl myosin sol subjected to 37° C., relative viscosity increases and flow anomaly appears, first slightly, then markedly (see Fig. 2 *b*, *c*). The particles must therefore become very much longer.*

*The restored flow birefringence intensity cannot be ascribed to the photo-elastic effect in a gel under strain because (a) anomalous viscosity appears before the relative viscosity has much increased, and (b) the angle of isocline remains about 70° showing that the particles are orienting freely.

Thus the physiological significance of the adenylpyrophosphate effect, which might at first sight seem to be lessened by experiments on simple salts, regains its force in that these themselves give reversible changes in flow birefringence and viscosity, which should throw light on the reversible changes in the intact muscle cell. One cannot, of course, compare too closely the behaviour of myosin in the muscle cell and myosin isolated in the form of a sol. In the muscle the contracting particles do work against resistance; in the sol this does not happen. It should be made clear, however, that potassium adenylpyrophosphate is more effective in causing immediate fall of flow birefringence than any of the other salts so far studied, 1–2 *M* concentrations not being nearly as effective as 0·1 *M* adenylpyrophosphate. None of the effects here described can be due to differences in the refractive index of the dispersion media used, since these are very small (within the limits 1·3336–1·3437). What connexion the reversible changes in flow birefringence here described have with those occurring in the birefringence of the intact muscle fibre remains to be determined. It is known from older work, put on a firm basis by v. Muralt[13] in 1932, that during a single isometric twitch the birefringence decreases by some 35 per cent, returning to its original value by the end of relaxation. It has also been found by Buchtal and Knappeis[14] that in the absence of contraction, changes in hydrogen ion concentration and salt concentration in the medium surrounding a contractile isolated muscle fibre bring about slower reversible changes in its birefringence. We doubt if there is much to be gained by referring to the myosin sol after its birefringence has fallen and it has begun to dephosphorylate adenylpyrophosphate as 'denatured', unless we are careful to say that the 'denaturation' (which involves neither changes of solubility, nor, as has been shown by Greenstein and Edsall[15] in the case of the salt effects, changes in titratable –SH linkages) has not gone beyond an early reversible stage at which it is compatible with active enzymic breakdown of the adenylpyrophosphate.

How exactly the adenylpyrophosphate interacts with the myosin in normal muscle remains unclear. But there is a suggestion in the facts already known (entertained for some time past by one of us (D. M. N.) and now put forward in a rather different form by Kalckar)[16] that myosin might be phosphorylated and dephosphorylated, occupying thus the last link in the chain of simultaneous transfers of phosphate ions and energy. As is well known, adenosinediphosphate can be phosphorylated according to circumstances by creatinephosphate, phosphopyruvic acid, or diphosphoglyceric acid. We suggest that while it acts as a phosphate acceptor towards these substances, adenosinetriphosphate (adenylpyrophosphate) acts as a phosphate donator towards the contractile protein itself. Contracted myosin would thus have adenylpyrophosphatase activity and phosphate would be transferred from the adenylpyrophosphate to some part of the protein molecule, which would simultaneously extend. Extended myosin would then be in phosphorylated form and charged with energy. When the physical changes touched off by the nerve stimulus occur, inorganic phosphate would be set free, and the energy available from this dephosphorylation used in contraction. It might even be, in view of the effects described in this note, that the contraction of the particles in the fibril would be occasioned by a sudden contact (brought about by changed permeability) with the resynthesized adenylpyrophosphate, the substrate, itself. Such possibilities obviously invite further study.

These experiments, which indicate that adenylpyrophosphate has a direct influence on the relative optical anisometry and on the shape of myosin particles, and possibly on their intermicellar forces, will be continued and extended as better optical and other apparatus becomes available.* They form part of a general investigation of the shape of protein particles arising out of an interest in the proteins of developing embryonic cells. Although they primarily concern the connexion between energy-transfer and myosin-fibril contraction, they are perhaps not without a relevance to inductor-reactor systems in embryos undergoing morphogenesis. The possibility should now be borne in mind that an inductor might be, not a co-enzyme or an auto-catalytically active protein, but a substrate, and that the changes in protein configuration which will lead to a specific histogenesis might be the result of the unavoidable action of an enzyme protein in the competent cell upon the inductor itself.

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* The authors wish to take this opportunity of thanking Prof. J. D. Bernal and Dr. J. F. Danielli for the stimulus and benefits of their conversation, and Prof. Tilley for the loan of valuable apparatus.

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OBITUARIES

Prof. A. Lapworth, F.R.S.

As a professor of chemistry, Arthur Lapworth will be remembered for his distinguished pioneer work on the mechanism of organic reactions and the reactivity of organic compounds, which was recognized in the award of the Davy Medal of the Royal Society. His colleagues in the University of Manchester and his many other friends will also remember, with gratitude and affection, such characteristics as his devotion to the maintenance of high intellectual standards in the University, his encouragement of co-operation between workers in different branches of science, his lively and expert interest in half a dozen fields outside his scientific work, and his sensitive sincerity and modesty.

After graduating at Mason College, later the University of Birmingham, where his father had become the first professor of geology, Lapworth began his research career in H. E. Armstrong's department at the City and Guilds Institute, South Kensington. The careful study of the sulphonation of the ethers of β-naphthol, for which he obtained his London D.Sc. in 1895 at the age of twenty-three, laid a foundation for his interest in aromatic substitution and isomeric change. With F. S. Kipping as senior collaborator he entered the terpene field with studies of bromocamphors and camphorsulphonic acids. Later, as lecturer in chemistry at the School of Pharmacy, Bloomsbury, he extended this work independently to the extent of some twenty papers, making particularly important contributions to the clearing up of the tangle of the monocarboxylic acids derived from camphoric acid. His report on the constitution of camphor, published by the British Association in 1900, is regarded as a classic.

Parallel with this work and later, when Lapworth had become head of the Chemistry Department at the Goldsmiths' Institute, he developed his characteristic contribution to the study of organic reactions. His attack on this problem shows two interacting aspects. On one hand he carried out fundamental investigations of the kinetics of a variety of organic reactions, which provided him with chosen foundations for theoretical discussion and many workers with a basis for extensive studies of further detail. On the other hand, he was always seeking generalizations concerning reactants and reactions which would be more comprehensive than the very limited analogies which were the stock in trade of organic chemists. He saw that very ambitious speculations would get lost in the bewildering mass of data concerning the behaviour of carbon compounds, but that progress could best be made in stages by accounting for well-chosen groups of related phenomena. Generalizations such as he put forward are necessarily open to a variety of criticisms, and it was only when, in the fullness of time, they were seen to build into wider theoretical conceptions, that the extraordinary soundness of Lapworth's insight gained full recognition. He combined what sometimes seemed almost artistic convictions about the significance of particular analogies and conceptions, with precision of thought in stating and applying them. Unfortunately, some of his critics skimmed over the outlines of his ideas, and on applying their impressions met with inevitable disappointments.

Lapworth's recognition in 1898 of the generality of isomeric changes of the form

$$M-R_\alpha-R_\beta=R_\gamma \rightleftharpoons R_\alpha=R_\beta-R_\gamma-M$$

led to his discovery that the γ-position in crotonic ester shows reactivity similar of that characteristic of the α-position in saturated esters. He first established essential features of cyanohydrin formation by a typically simple colorimetric method using yellow camphor-quinone, and from this beginning he developed comparisons of the properties of the carbonyl group and of the ethylene bond in αβ-unsaturated carbonyl compounds. He also formulated the accepted mechanism of the benzoin condensation. His interest in the relation between tautomeric change and aromatic and aliphatic substitution led to fundamental experiments on the halogenation of acetone and of carboxylic acids. The study of the effect of acids on enolization, and hence on halogenation, was followed by physico-chemical investigations on the catalytic activity of hydrogen ions, including consideration of the effect of adding water to acids in organic solvents. In 1909, at an early stage of this work, Lapworth was appointed senior lecturer in inorganic and physical chemistry and assistant director of the Inorganic Chemical Laboratories in the University of Manchester. His continuation of the work on ionization, together with lecturing requirements, gave him a grasp of thermodynamics which was an important element in his later thought.

Turning again to organic chemistry, Lapworth established a number of properties of sulphonic esters, contrasting their tendency to detachment of the alkyl group with that of carboxylic esters to reactions involving detachment of alkoxyl. In 1913 he was elected to the Royal Society and appointed to succeed W. H. Perkin, junior, as professor of organic chemistry in Manchester. The war of 1914–18 soon interrupted publications, except for a small group on the constituents of brain tissue and the pungent principles of ginger.

In 1920 Lapworth published his principle of alternate polarities. In this he focused attention on the polar properties induced in aliphatic and aromatic compounds by substitution, as shown by the study of the characteristic activity of the various atoms in molecules of both types. He also emphasized how unsatisfactory were the terms 'electronegative' and 'electropositive' as applied to groupings in organic molecules, and stressed the significance of the classification of groups according to their general influence on acidic or basic properties of compounds. He developed these views later, based successful experiments on them and, partly by his publications such as those in 1922 but also by personal discussions, he helped in laying the foundations on which Robinson based a more general and clearer interpretation of these phenomena in electronic terms. Most valuable was his classification of reactants in organic reactions as anionoid and cationoid (1925), which fused conceptions of organic reactivity with those by which acids and oxidizing agents are recognized as electron acceptors, and bases and reducing agents as electron donors. The condensed nature of this publication and the renaming of these classes by Ingold eight years later should not obscure the fundamental nature of Lapworth's contribution.

Among his work on the subsequent developments of electronic conceptions one may notice particularly the recognition, in 1928, that the effect which was afterwards given a physical interpretation as resonance must be regarded as affecting the average molecules of the reactants, and that the polarizability of molecules was not an adequate explanation. These theoretical extensions were made in discussing further experimental studies of the cyanohydrin and other reactions.

In all this original work Lapworth's theoretical insight and his skill with simple experimental methods were combined with an extraordinary grasp of general chemistry. It was therefore natural that as a teacher, lecturing on physical, organic and general inorganic chemistry in succession, he should concern himself to an unusual degree with the exposition of ideas, methods and general principles, so that his lectures were most stimulating and valuable to his better students, though they might be the despair of some who wanted only the easy catalogue of information.

By taste and temperament Lapworth was a scholar and investigator rather than an administrator, but he was called to be director of the Chemistry Laboratories at Manchester for a dozen years. Throughout this period he had invaluable help from his wife in handling departmental details, and his own qualities brought to him the affection and full support of his colleagues. The first half of his period as director saw the fruitful collaboration between himself and Prof. (now Sir Robert) Robinson, whom the University was able to invite to become professor of organic chemistry in 1922 through Lapworth's ability to transfer from that chair to the inorganic and physical side. When Robinson went to London in 1928, Lapworth made his objective the development of the school of physical chemistry in Manchester to full stature, through the appointment of a professor of established reputation to a new chair in that branch of chemistry, while maintaining the traditional strength of the organic side of the department. During the five years which, as it transpired, were necessary to achieve this, he was responsible for the whole department and, with characteristic sacrifice of personal and temporary interests, he considered it necessary to maintain it on the most economical basis to provide for the maximum expansion of equipment and opportunity when he would be handing over. It will generally be agreed that with the appointments of Prof. I. M. Heilbron and Prof. M. Polanyi the object which he set himself, and which the University adopted, was fully achieved. But for the present war it would have been rounded off by a new building for physical chemistry, in addition to the re-equipping of the existing laboratories which his successors carried out.

After the severe strain of these years of responsibility, Lapworth's health, which was never robust, broke down, but a period of rest and care enabled him to enjoy again the visits of his friends and some of the many hobbies and recreations which he had cultivated with remarkable skill and thoroughness. Music had run through his whole life. He had represented the University on the council of the Royal Manchester College of Music for more than twenty years. His taste was thoroughly sound, and he played the violin well and with great enjoyment. At his house one might have chamber music, or talk of fishing or of the arrival of migrant birds on an Easter holiday, or perhaps an exposition of microscopy or a wireless speciality, or reminiscences of mountaineering, or news of the latest from the theatre or the films—indeed the most diverse interests and lively comment. Many of his friends will retain pleasant memories of these occasions.

G. N. BURKHARDT.

Dr. R. T. Beatty

DR. RICHARD THOMAS BEATTY, whose death was announced recently, was a member of the Admiralty Scientific Staff and was born at Dungannon on April 26, 1882. He was educated at the Royal School, Dungannon, and Queen's University, Belfast, where he afterwards became lecturer in experimental physics.

Beatty worked for some years at the Cavendish Laboratory where he became interested in what were then known as homogeneous or characteristic X-rays. He was exciting this radiation and the associated secondary electrons and making a number of pioneer observations in this field. These observations were among those which helped to lay the experimental foundations of the quantum idea which was only then beginning to take shape. Between 1907 and 1920 he published a number of papers, mainly in the *Philosophical Magazine* and the *Proceedings of the Royal Society*, on this and related subjects.

Beatty served at the Admiralty in a temporary capacity in the War of 1914–18, and was engaged in research work at Portsmouth. In 1920 he joined the permanent scientific staff of the Admiralty.

WE regret to announce the following deaths:

Squadron-Leader J. O. Hinks, formerly Armourers and Brasiers' research fellow in aeronautics at Cambridge, on active service, aged twenty-nine.

Prof. W. Vogt, professor of anatomy in the University of Munich, noted for his work on the embryology of the Amphibia, on March 17.

NEWS AND VIEWS

The King's Birthday Honours

The following names of scientific men and others associated with scientific work appear in the King's Birthday Honours List:

Baron: Prof. F. A. Lindemann, personal assistant to the Prime Minister, professor of experimental philosophy, Oxford.

G.B.E.: Viscount Nuffield.

K.C.B.: Sir George Gater, permanent Under-Secretary of State for the Colonies and secretary, Ministry of Home Security, formerly clerk and education officer to the London County Council.

K.C.M.G.: Mr. Frank Gill, for services in development of the telephone industry and of international telephony; Dr. H. H. Scott, director of the Bureau of Hygiene and Tropical Diseases, London.

Knights Bachelor: Col. A. S. Angwin, Engineer-in-Chief, General Post Office; Mr. R. W. Gillespie, a founder of the Fairbridge Farm Schools in Australia; Prof. J. P. V. Madsen, professor of electrical engineering, University of Sydney, and chairman of the Radio Research Board, Australia; Dr. P. H. Manson-Bahr, for services to tropical medicine and as consulting physician to the Colonial Office; Mr. K. G. Mitchell, consulting engineer (roads), India; Mr. E. B. Pratt, managing director, Imperial Chemical Industries (India), Ltd.; Prof. J. B. S. Stopford, vice-chancellor, University of Manchester.

C.B.: Mr. C. A. Taylor, regional director, London Telecommunications, General Post Office; Mr. F. A. Whitaker, civil engineer in chief, Admiralty.

C.M.G.: The Hon. F. E. Harris, Minister of Agriculture and Lands, Minister of Supply, Industry, and Post-war Development, Southern Rhodesia; Dr. S. A. Neave, assistant director, Imperial Institute of Entomology; Dr. H. A. Tempany, agricultural adviser to the Secretary of State for the Colonies.

C.I.E.: Mr. W. Meiklejohn, senior conservator of forests, Bengal; Mr. C. F. C. Beeson, forest entomologist and conservator, Government of India.

C.B.E.: Prof. F. C. Bartlett, professor of experimental psychology in the University of Cambridge, and a member of the Flying Personnel Research Committee; Maj. G. P. Bulman, director of engine development and production, Ministry of Aircraft Production; Mr. W. Deacon, president of the Pharmaceutical Society of Great Britain; Mr. W. A. Elder, principal veterinary and agricultural officer, Swaziland; Mr. R. H. Franklin, assistant secretary, Ministry of Agriculture and Fisheries; Dr. J. A. Glover, lately senior medical officer, Board of Education; Mr. P. Good, deputy director, British Standards Institution; Mr. M. T. Tudsbery, civil engineer to the British Broadcasting Corporation; Dr. R. Wilson, Commonwealth statistician and economic adviser to the Treasury, Australia.

O.B.E.: Prof. J. F. Baker, professor of civil engineering, University of Bristol, and scientific adviser, Research and Experiments Branch, Ministry of Home Security; Lieut.-Col. T. H. Battye, director of statistics, Department of Supply, India; Mr. T. Beacall, an assistant comptroller, Patent Office; Dr. R. C. Bowden, assistant director, Ordnance Factories, Ministry of Supply; Prof. T. H. Davey, director, Sir Alfred Lewis Jones Research Laboratory, Sierra Leone; Dr. A. G. Francis, deputy Government chemist; Mr. E. E. L. Grundy, Principal, Technical School, Jamalpur; Mr. J. B. Nevitt, general manager, Ammunition Dept., Imperial Chemical Industry (Metals), Limited; Dr. S. J. Saint, director of agriculture, Barbados; Maj. L. Sealey-King, district officer, Nigeria; Khan Bahadur Maulvi Zafar Hasan, lately Superintendent, Archæological Survey, Northern Circle, Agra.

M.B.E.: Lala Kundan Lal Aggarwal, deputy conservator of forests, Punjab; Mr. L. C. Giles, assistant district officer, Nigeria; Mr. P. W. Harris, district officer, Kenya; Mr. J. T. Kennedy, senior assistant livestock officer, Uganda; Mr. P. E. Keam, Council for Scientific and Industrial Research, Australia; Sohan Lal, principal, School of Engineering, Orissa; Mr. K. W. Switzer, district officer, Nyasaland.

I.S.O.: Mr. J. L. Oliver, lately a native commissioner, Southern Rhodesia; Lieut.-Colonel F. J. Wane, for services as a native commissioner in Southern Rhodesia; Mr. S. B. Williams, district commissioner, Swaziland; Mr. S. B. Brewer, head of the Technical School Section, Board of Education; Mr. H. Chambers, principal, Ministry of Agriculture and Fisheries; Mr. J. Getty, chief inspector, Ministry of Agriculture, Northern Ireland.

> On the outbreak of war, it was obvious that restrictions would have to be imposed on the use of paper. By adopting a slightly thinner paper, and the curtailment or omission of certain sections of Nature, it has been possible to retain its more important features. Further reductions in size are now being imposed, but every effort will be made to ensure that no vital characteristic of the journal is impaired.
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> The publishers regret to have to announce that, on account of increased costs, the price of Nature as from and including the issue of July 5 will be 1*s.* 6*d.*

Prof. F. A. Lindemann, F.R.S.

All who know Prof. F. A. Lindemann, professor of experimental philosophy in the University of Oxford, will be glad that the King has conferred the honour of a barony on him. Prof. Lindemann is one of the few men of science to rise to a position of influence in affairs in our time and quite possibly the youngest man of science ever to be elevated to the House of Lords. Those who profess to see in him merely "the man of mystery behind Churchill" or who laud him as the inventor of everything or depreciate him as the thwarter of all good schemes, do injustice to a man of great personality and remarkable parts. At the Prime Minister's right hand he is peculiarly well placed. His foresight, his wide knowledge of the scientific problems that the age and the War have brought forth, his great ingenuity, never more acutely shown than when difficulties are greatest, and his abundant courage, are, perhaps, his most serviceable qualities. There is one other quality, however, of great importance. Prof. Lindemann has a knowledge of the mentality of the French and Germans (he was educated at Darmstadt, Berlin and Paris) which few of the Government advisers could have and more 'realistic' than official advisers or diplomats seem to have had. This Continental experience of his, no less than his scientific insight and personal gifts, should stand him in good stead as a member of the Upper House, and in his present responsible position.

The Right Hon. Winston Churchill, F.R.S.

A unique ceremony took place in the Cabinet Room at 10 Downing Street on June 12, when the President of the Royal Society, Sir Henry Dale, admitted the Prime Minister into the fellowship of the Society. Among those present were the Society's biological secretary, Prof. A. V. Hill, M.P., the physical secretary, Prof. A. C. G. Egerton, the foreign secretary, Sir Henry Tizard, and the assistant secretary, Mr. John D. Griffith Davies. After the Prime Minister had signed his name in the ancient Charter Book, Sir Henry Dale showed him the signature of his ancestor, Sir Winston Churchill, father of the great Duke of Marlborough, who was one of the early fellows of the Society, having been admitted into the fellowship in 1664.

The Union Observatory, Johannesburg

The Union Astronomer, Dr. H. E. Wood, director of the Union Observatory, Johannesburg, retired on February 3. Dr. Wood, who was educated at the University of Manchester, was appointed assistant at the Transvaal Observatory, under the directorship of the late Dr. R. T. A. Innes in 1908. The work of that Observatory had been largely meteorological, of a routine nature, but after the appointment of Dr. Innes as director, the astronomical work was developed, new instrumental equipment was obtained and the Observatory—the name of which was changed to the Union Observatory in 1912—became one of the most important in the southern hemisphere. Dr. Wood succeeded Dr. Innes as Union Astronomer, on the latter's retirement in 1927. He has been particularly interested in the observation of minor planets and comets; he discovered many new minor planets and computed many orbits of minor planets and comets. Dr. Wood has also been an assiduous observer of occultations of stars by the moon, and the large number of occultations observed at the Union Observatory for many years has been of the greatest value in the study of the moon's motion. Dr. Wood has been closely associated with the South African Association for the Advancement of Science, of which he was for many years one of the secretaries and of which he was president in 1931.

Dr. H. E. Wood has been succeeded as Union Astronomer by Dr. van den Bos, who started his astronomical career as an assistant at the Leyden Observatory. A scheme of co-operation between the Union Observatory and the Leyden Observatory had been arranged, under which the Leyden Observatory—which has a large staff but poor observing conditions—should station one member of its staff at the Union Observatory—which has a small staff but good observing conditions—to whom all necessary facilities should be offered. Under this scheme Dr. van den Bos, whose primary interest is double-star observation, went to Johannesburg in 1926 to make observations of double stars with the large 26½-in. visual refractor. In 1927 he was transferred to the staff of the Union Observatory, becoming chief assistant in succession to Dr. Wood, on his appointment as Union Astronomer. Dr. van den Bos is not only an assiduous and accurate double-star observer but has also computed many double star orbits. With the collaboration between Dr. van den Bos and Mr. Finsen, one of his assistants, the Union Observatory is now making a more important contribution than any other observatory to double star astronomy. Among interesting observations made by Dr. van den Bos and Mr. Finsen have been the apparent triplicity of Nova Pictoris, a few years after its outburst, the three nuclei showing a progressively increasing separation; also the figure-of-eight appearance of the asteroid Eros at the 1931 opposition, which rotated in the period of the variation of brightness of Eros.

U.S. National Academy of Sciences: Recent Elections

At the annual meeting of the U.S. National Academy of Sciences, recently held at Washington, the following were elected foreign associates: Prof. E. D. Adrian, professor of physiology in the University of Cambridge; Prof. A. V. Hill, secretary of the Royal Society and Foulerton research professor (Nature, May 10, p. 573); Sir Arthur Keith, formerly Hunterian professor of the Royal College of Surgeons (Nature, May 24, p. 639).

The following American men of science were elected to membership: Prof. W. E. Bachmann, associate professor of chemistry in the University of Michigan; Dr. R. J. Dubos, associate in bacteriology in the Rockefeller Institute for Medical Research; Prof. E. A. Graham, professor of medicine in Washington University (St. Louis); Dr. A. S. King, superintendent of the physical laboratory, Mount

Wilson Observatory; Prof. C. C. Lauritsen, professor of physics in the California Institute of Technology; Dr. A. L. Loomis, director of the Loomis Laboratories, Tuxedo Park, N.Y. (physics); Prof. J. R. Oppenheimer, professor of physics in the University of California; Prof. J. T. Patterson, director of zoological research in the University of Texas; Prof. Karl Sax, professor of botany in Harvard University; Dr. G. G. Simpson, associate curator of vetebrate palæontology in the American Museum of Natural History; Dr. Joseph Slepian, Westinghouse Electric and Manufacturing Company (electrical engineering); Dr. L. F. Small, National Institute of Health (organic chemistry); Dr. W. M. Stanley, associate member in biophysics of the Rockefeller Institute for Medical Research; Prof. T. Y. Thomas, professor of mathematics in the University of California at Los Angeles; Prof. G. B. Wislocki, Parkman professor of anatomy in Harvard University.

University College, Nottingham: Air-Raid Damage

NOTTINGHAM University College buildings in Shakespeare Street have been damaged by a high explosive bomb of heavy calibre. The Departments of Mining and Textiles occupy the Shakespeare Street buildings. The Faculties of Arts and Pure Science and the Departments of Engineering are housed in University Park buildings. The main damage was confined to the west wing of the building, the principal lecture theatres and laboratories, though seriously damaged, escaping destruction. The Mining and Fuels Department was almost completely destroyed, including practically the whole of its valuable apparatus.

In the Textiles Department, which was housed in that section of the building formerly occupied by the Natural History Museum until it was transferred to Wollaton Hall, some of the hosiery machinery was salvaged, but much damage was done to the general structure of that part of the building. Blast broke windows, removed doors and blew down plaster, etc., in practically all parts of the building.

German Aircraft Design

TECHNICAL details now available of the new German fighter, Messerschmitt 109*F*, indicate the general trend of enemy aircraft design towards high altitude operation. The machine, a modification of earlier Messerschmitt fighters, is clearly designed not only to reach great heights, but also to retain climb and general manœuvrability at those altitudes, without which the operation of air fighting is at a tactical disadvantage. It is claimed that this design has a service ceiling of 38,000 ft., but the attainment of this height alone has little advantage, it being necessary to retain a speed of manœuvre better than the opposing aircraft, for fighting purposes.

The wing area has been increased, an alteration necessary for this effect, but disadvantageous in many other respects. The amount of armament has been decreased to one cannon and two machine guns. Weight reduction is also an advantage for high altitude work, but a lessening of fire power has obvious drawbacks in a fighter. All guns are now enclosed in the body, the outboard ones on the wings being discarded. The concentration of weight nearer the centre of the machine would improve the quickness of the response to lateral control. Possibly it also reduces the weight and complication of the arrangement for heating the guns, as they would be nearer to the engine, the most convenient source of heat available. It is essential in high altitude flying to prevent freezing up of guns, while they are not in action, by some externally applied heat.

Engineering Economy and Æsthetics

THE Council of the Institution of Civil Engineers has recently given consideration to the need to foster among engineers the closer study of: (*a*) the economics of engineering projects; (*b*) the organization and management of engineering work; and (*c*) the relations of æsthetic considerations to engineering design and construction. It is believed that in the period of reconstruction and development which will follow the War these subjects will become of increasing importance, and in the national interest should form a part of the equipment with which engineers should be furnished in order that they may adequately play their part in the task before them. The Council accordingly intends to examine all possible means by which the Institution can influence the better understanding of engineering economics and æsthetics, not only by students resident at the universities, but also by those otherwise engaged in their engineering training, so that eventually a study of these subjects may form an integral part in the recognized education of all engineers.

As a beginning, the Council of the Institution approached the University of Cambridge with an offer to finance for a period of five years a lectureship on the subjects envisaged in the hope that they would in due course form part of the engineering curriculum of the Mechanical Sciences Tripos. The proposal was cordially welcomed, and has now been accepted in principle by the Council of the Senate of the University; but its full adoption will necessitate some reconsideration of the scheme of instruction in the Engineering School and possibly of the Mechanical Sciences Tripos, which it would be impracticable to undertake in war-time. Nevertheless, during the next academical year, a number of eminent engineers and others will be invited to visit the University to give either single lectures or short courses on subjects coming within the terms of the proposal.

Foreign Periodicals in War-time

THE Association of Special Libraries and Information Bureaux is undertaking a survey in Great Britain of the present position in regard particularly to enemy and enemy-controlled publications, especially the current issues of periodicals. Previous explanatory surveys have confirmed the impression that since the early part of 1940 only very limited supplies of such publications have been arriving in Great Britain; that they consist mainly of imperfect sets of a relatively few periodicals restricted very largely to departmental libraries that are not accessible to the general public; and that there is widespread dissatisfaction and a sense of frustration among students and intellectual workers generally as well as among research workers and technologists intimately associated with the war effort. Nothing short of a fully representative, detailed and documented survey can reveal the inadequacy of the present supplies. Through the good offices of the Royal Society, the Rockefeller Foundation has provided funds for the conduct of a rapid, extensive survey of this character.

The survey will be made by a Committee of the Association and will be completed by the autumn. A memorandum is being circulated to some two thousand institutions and individuals to ascertain what publications they need and the extent to which they are locally available. In the interim, endeavours will be made to facilitate the distribution of available supplies, but the primary objective is to obtain a detailed inventory of needs and to ascertain what further supplies are essential to meet demands. Those interested should communicate with the ASLIB Foreign Periodicals Committee, 31 Museum Street, London, W.C.1.

Medicinal Herbs

THE Committee recently appointed by the Ministry of Health to consider what steps should be taken to secure organization of cultivation and collection of vegetable drugs has presented an interim report. The committee, of which the chairman is Sir Weldon Dalrymple-Champneys, considers that, so far as domestic production is concerned, attention should be concentrated on the following: Agar, dill, belladonna, Irish moss, colchicum, digitalis, ergot, male fern, liquorice, henbane, peppermint, psyllium, sphagnum, stramonium, dandelion and valerian. The committee is thus in agreement with the recommendations of the Medical Research Council, which advised, in M.R.C. War Memorandum No. 3, that all these drugs, with the exception of agar, should be produced in the United Kingdom; with regard to agar, the M.R.C. Memorandum recommended that its production should be encouraged in the British Empire overseas. Concerning the collection of herbs which grow wild, the report of the committee of the Ministry of Health states that steps have already been taken to encourage it on methodical lines, and commends the efforts of the Boy Scouts Association in this direction; the Association has circulated a pamphlet giving details of identification, methods of collecting, drying and dispatch, in respect of several vegetable drugs and has arranged that the trade will purchase the collections so made. The Royal Botanic Gardens, Kew, have conferred with the National Association of Women's Institutes to organize the collection of important herbs in each county, the selection of the herbs to be determined by their local abundance.

State Laboratory of Eire

THE report of the State Chemist of Eire upon the work of the State Laboratory for the year ending March 31, 1941, has been issued in typescript form. The Laboratory carries out chemical work for all departments of the Government of Eire, the greater portion being performed in the Laboratory in Upper Merrion Street, Dublin, but samples of wines, spirits and tea are also examined at the chemical station in the Custom House, Cork. The total number of samples examined in the course of the year, including those dealt with at Cork, was 29,571, as compared with 37,843 in the preceding year, a decrease of 8,272. Of this figure, 531 samples represent the decrease at Cork Chemical Station. The decrease in the number of samples examined was mainly in respect of those received for the Revenue Commissioners and the Department of Agriculture and Fisheries. There was a large fall in customs import samples, particularly in regard to wines and spirits; the fall in the number of samples received from the Department of Agriculture and Fisheries was due to the impossibility of obtaining dairy instruments from the Continent and the cessation of sea water sampling. Increases were registered in respect of 'wrecked goods', and additional samples of feeding stuffs were examined in order to control any possibility of adulteration due to shortage in supplies. The development of the Milk and Dairies (Special Designations) Regulations led to an increased number of tests being carried out for the Department of Local Government and Public Health. The introduction of the phosphatase test has enabled close control of pasteurization to be achieved; investigation of plants yielding milk failing on this test has always revealed defects corresponding to the result of the test. A variety of specimens has been examined for the Department of Justice during the year.

Trichinosis in Britain

AT a meeting of the Section of Epidemiology and State Medicine of the Royal Society of Medicine on May 22, Dr. P. B. Beeson, of Harvard University, read a paper on factors influencing the prevalence of trichinosis in man. He said that few cases of trichinosis have been recognized in Great Britain until recently, although the disease occurs fairly commonly in Europe and the United States. Within the past few months, however, several outbreaks have been reported in different parts of England and Wales, which have evoked a new interest in the clinical and epidemiological aspects of the disease. Since human trichinosis is nearly always acquired by eating pork, knowledge of the ways in which swine become infested is important. In the United States, where 0·5–5·0 per cent of swine has trichinosis, the chief factor responsible is the practice of feeding swine on uncooked garbage. In Great Britain there is little opportunity for this means of swine infestation to take place, and the probability is that the rare cases of swine trichinosis which occur in this country are acquired by eating infested rats. Trichinosis has been found in rats in several parts of Great Britain.

Locally manufactured sausages appeared to have been the meat responsible for the recent epidemics of human trichinosis in Great Britain. In explanation of the large number of people involved in some of these epidemics, it was pointed out that rationing of meat and changes in the composition of sausages have brought about a condition whereby an unusually large number of people eat the meat of a single animal. Furthermore, in view of the fact that a partially protective immunity develops after one attack of trichinosis, comparative susceptibility of the British population might have led to the development of more clinical cases than would have resulted from similar exposure of a previously exposed population. The measures indicated for prevention of the disease are destruction of rats and education of the public about the danger of eating raw or undercooked pork.

Announcements

SIR D'ARCY THOMPSON, professor of natural history in the University of St. Andrews, has been elected a member of the American Philosophical Society.

PROF. R. W. WOOD, research professor of experimental physics in Johns Hopkins University, has been awarded the Henry Draper Medal of the U.S. National Academy of Sciences "in recognition of his contributions to astronomical physics".

DR. MAX NONNE, professor of neurology at the University of Hamburg, has recently been awarded the Goethe Medal for Art and Science on the occasion of his eightieth birthday.

PROF. OTTO HAHN, director of the Kaiser Wilhelm Institute for Chemistry, Berlin-Dahlem, has been awarded the Copernicus prize for 1941, by the University of Königsberg for his work on radioactivity.

PROF. JACQUES ERRERA, formerly professor of physical chemistry in the University of Brussels, has been appointed manager of the Research and Control Division of Sidney Blumenthal and Company at Shelton, Conn.

MISS J. P. STRACHEY will retire shortly from the principalship of Newnham College, Cambridge, which she has held since 1923, and the fellows of the College have elected as her successor Miss Myra Curtis, associate and fellow of the College and principal assistant secretary to the War Damage Commission.

THE late Sir Charles Clifford by his will left a share of his residuary estate to the University of Sheffield. Since the death of Lady Clifford on May 1, the residuary estate falls to be divided between the beneficiaries. It is expected that the University will receive upwards of £50,000, after duties have been paid.

The following appointments have recently been made: Dr. V. M. Conway, assistant lecturer; Dr. L. Leyton and Mr. A. N. Barker, temporary demonstrators; Mrs. E. M. Harrison, part-time assistant in the Department of Botany.

AT the annual general meeting of the Institute of Physics held on June 4, the following were elected to take office on October 1, 1941: *President*, Sir Lawrence Bragg; *Vice-President*, Prof. W. Makower; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Sercetary*, Prof. J. A. Crowther; *Ordinary Members of the Board*, Prof. J. Chadwick and Mr. D. C. Gall.

AT the annual general meeting of the Marine Biological Association of the United Kingdom, Dr. George Parker Bidder was re-elected president. The list of officers and vice-presidents also remains unchanged. As new members of Council, Dr. C. F. A. Pantin, Prof. T. A. Stephenson, Prof. W. M. Tattersall, Prof. C. M. Yonge and Mr. J. Z. Young were elected.

MR. R. S. HUDSON, Minister of Agriculture, has announced the appointment of an Agricultural Improvement Council for England and Wales, to devise methods for seeing that promising results of research are brought as rapidly as possible into ordinary farming practice. The Council will advise from time to time on agricultural problems that seem to need scientific investigation. It will consist of a chairman and twelve members, appointed for three years with the possibility of re-appointment, and will include practical farmers as well as distinguished men of science.

THE Bernard Baron Trustees have offered the Royal College of Surgeons £40,000 to endow a Bernard Baron research professorship at the College. In a letter making the offer, the Trustees state that they appreciate that a large part of the resources of the College will have to be devoted to the erection of new buildings and the assembling of new collections to replace the damage done to the College during air raids, and they have made the offer of a research professorship in order that research being carried out at the College may not suffer. The laboratories at the College provided by the Trustees fortunately have not been damaged structurally, and the valuable equipment they contained had been removed to improvised accommodation in the country.

A NINTH Summer Conference on Spectroscopy and its Applications will be held at the Massachusetts Institute of Technology during July 21–23. The conference will repeat to a considerable extent the type of programme presented at the conferences held during the past eight summers. The early sessions will be devoted principally to applications of spectroscopy to the analysis of materials. Other topics to be considered are absorption spectrophotometry, photographic photometry, biological and chemical effects of spectral radiation, industrial applications of spectroscopy, analysis of spectra and the measurement of wave-lengths. Further information can be obtained from Prof. G. R. Harrison, Massachusetts Institute of Technology, Cambridge, Massachusetts.

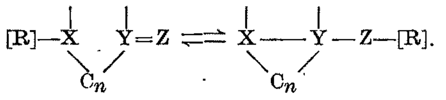
LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

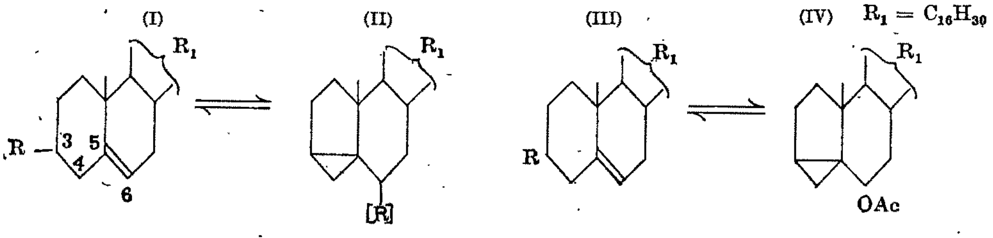
In the present circumstances, proofs of "Letters" will not be submitted to correspondents outside Great Britain.

Pentacyclic Steroids

The arrangement of carbon atoms indicated by X, Y and Z in the following scheme is contained in many unsaturated steroids and constitutes a potential tautomeric system according to the general scheme

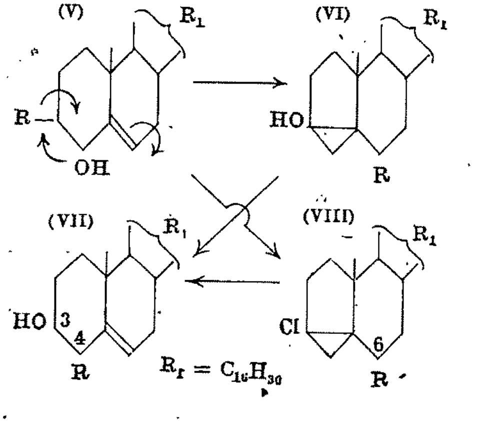


As the carbon atoms concerned (3, 5 and 6 in I) are components of a cyclic system, being members of ring A and B of the tetracyclic steroid ring system, the resulting tautomeric change would be a transannular one and involve the formation of a bridge-linkage from C_3 to C_5. Such an intramolecular rearrangement would therefore lead to a pentacyclic system as indicated in (II).



This transannular change has evidently occurred during the formation of *i*-cholesterol from cholesterol[1], for which so far no explanation has been offered: cholesteryl *p*-toluenesulphonate (III, R = *OTs*) is converted by an anionotropic change into *i*-cholesteryl acetate (IV). The reaction is reversible since cholesteryl acetate (III, R = *OAc*) is easily obtained from (IV).

In studying the puzzling reactions of the unsaturated α-glycol, *cis*-3 : 4-Δ^5-cholestene diol[2], we have now found that transannular rearrangements of the above type offer a rational interpretation of the observed facts. The two possible monoesters of the glycol have been obtained by various methods and the position of their esterified OH group has been established. The 3-monoesters (V, R = *OAc*, *OBz*, etc.) result *inter alia* from the action of acyl- or aryl-chlorides on the diol, whilst the 4-monoesters (VII) are smoothly formed at room temperature by the interaction of cholesteryl dibromide with the silver salts of the respective acids in pyridine solution as well as from cholesteryl esters and SeO_2 under well-defined conditions. The remarkable fact has also been established that an acyl migration from C_3 to C_4 occurs when the aliphatic 3-monoesters are warmed to 90° in acetic acid solution. This novel reaction, which has no analogy in the steroid series, becomes intelligible on the assumption of an intramolecular rearrangement and the intermediate formation of the labile pentacyclic compound (VI). Rupture of the bridge linkage, followed by the allylic change usual in these compounds then leads to VII.



The same mechanism accounts for the unexplained migration of a benzoyl group from C_3 to C_4 in the 3-benzoate of 6-chloro-Δ^4-cholestene[3]. This substance is obtained from the 3-monobenzoate of the *cis*-diol (V, R = *OBz*) by the action of $SOCl_2$ and, reacting in the tautomeric form (VIII, R = *OBz*) yields the 4-monobenzoate (VII, R = *OBz*) on replacement of Cl by OH.

An alternative mechanism of acyl migration, involving the formation of ortho-carbonic esters as intermediates, will be discussed in the detailed account of this work.

Further, there is evidence in the literature of the sex hormones that pentacyclic steroids may occur as normal or pathological metabolic products of the animal organism. Two derivatives of this type, in the androstane and pregnane series respectively, are known as laboratory products[4]. The bridge-linkage in these substances is easily broken by contact with dilute HCl at room temperature. The resulting product in the androstane series is 3-chloro-dehydroandrosterone, a substance which has frequently been isolated from normal and pathological urines. In urine it originates obviously from a labile precursor, during the usual preliminary hydrolysis with dilute HCl in the isolation procedure. The ease of its formation seems to indicate this precursor to be a 6-monoester of *i*-dehydroandrosterone, which, owing to its lability, has so far escaped isolation (cf. also 3 : 5-androstadienone[5] and other substances isolated from the urine of adrenal tumour cases[6]).

Experimental details of this work will be published elsewhere as soon as circumstances allow, in conjunction with Dr. V. A. Petrow and Mr. W. W. Starling. Work on analogous rearrangements in ring B of the steroids is in progress.

O. ROSENHEIM.

National Institute for Medical Research,
London, N.W.3. May 8.

[1] Wallis, Fernholz and Gephart, *J. Amer. Chem. Soc.*, **59**, 137 (1937); Beynon, Heilbron and Spring, *J. Chem. Soc.*, 1459 (1937).

[2] Rosenheim and Starling, *J. Chem. Soc.*, 377 (1937).

[3] Spring and Swain, NATURE, **146**, 718 (1940); *J. Chem. Soc.*, 83, (1941).

[4] Butenandt and Grosse, *Ber.*, **69**, 2776 (1936); **70**, 1446 (1937).

[5] Burrows, Cook, Roe and Warren, *Biochem. J.*, **31**, 950 (1937).

[6] Wolfe, Fieser and Friedgood, *J. Amer. Chem. Soc.*, **63**, 582 (1941).

Correlation between Sex-, Thyroid- and Adrenal Cortical Hormones

EXPERIMENTS were performed on 168 adult gonadectomized male and female rats. The following hormones were administered, the figures representing the dose given per week: androsterone 4·5 mgm., testosterone propionate 0·75 mgm., œstradiol benzoate-butyrate 0·015 and 0·09 mgm., desoxycorticosterone acetate 2–4 mgm. (also tablets of this hormone were implanted subcutaneously), desiccated thyroid powder 90–480 mgm., thyroxine sodium 1–3 mgm.

A co-operative stimulating effect on the weight and size of the organs was recorded between œstrogenic and thyroid hormones in the case of female sex organs, liver, kidneys and (less definitely) heart and spleen. Hypertrophy of the adrenals was also greater with these two hormones than with either hormone alone.

A similar stimulating co-operative effect was noticed between the male sex hormone androsterone and thyroid hormones in females, or desoxycorticosterone and thyroid hormones on the weight and size of liver, kidneys, heart and, less constantly, spleen, but not on sex organs.

Desoxycorticosterone, when injected alone, produced only a slight increase in weight of kidney and liver.

The following changes in weights of organs illustrate some of the above statements. In control ovariectomized rats' average weights were as follows: liver 7·22 gm., kidneys 1·53 gm. and heart 0·828 gm. The respective weights in rats treated with a large dose of thyroid hormones were 9·53, 2·41 and 1·158 gm.; in rats, receiving androsterone and thyroid hormones 10·75, 2·44 and 1·345 gm.; in rats receiving oestrogenic and thyroid hormones 13·2, 2·98 and 1·383 gm., while in rats receiving oestrogen alone 9·03, 1·79 and 0·921 gm.

On the other hand, the hypertrophy of the adrenals and the retardation of body growth produced by thyroid hormones was decreased when male hormones were administered simultaneously, the latter exerting a partial neutralizing (antagonistic) action on these effects of thyroid hormones.

V. KORENCHEVSKY.
K. HALL.

Lister Institute of Preventive Medicine,
London, S.W.1. May 15.

Blackening of Potato Tubers on Boiling

IT has been shown that the black coloration which appears in some potato tubers after boiling cannot be melanin, as the colour disappears rapidly in acid solution at about *p*H 3·0; at this *p*H melanin is quite stable. The bleached pigment appears to be soluble in acid solution, but the grey coloration partially reappears on neutralizing the acid with buffer solution at *p*H 7·0. No correlation was observed between the development of the pigment and the activity of the enzyme tyrosinase as estimated by the Warburg technique. Neither could any correlation be found between the blackening and the tyrosine content of the potatoes. It was observed that among the varieties tested there appeared to be two distinct levels of tyrosine content: King Edward and Majestic with 40–60 mgm. per 100 gm. fresh weight, and Kerr's Pink and Arran Banner with 8–25 mgm.

The pigment was found to develop as well after heating in alcohol as in water, but in neither case did it appear until oxygen was admitted. The pigment and its colourless precursor were both insoluble in 60 per cent alcohol. As shown by the unpublished work of Pearse, pieces of potato 1 cm. thick require a minimum of two minutes boiling for any black colour to develop, and for full coloration a total of five minutes is required, although this can be spread over several separate periods.

Attempts to isolate the grey pigment from boiled potato failed, but led to the suspicion that the pigment might be an iron compound. Estimation of the iron content of a large number of tubers showed a marked correlation between iron content (as extracted by 20 per cent sulphuric acid) and the incidence of blackening in tubers drawn from the same sample; blackening tubers contained in every case more iron than the normal ones. The correlation was not so clear when comparison was made between tubers from different samples, but on this point further work is required.

Nearly the whole of the extractable iron in the tubers appeared to be in the ferrous state. No reliable results for total iron could be obtained by micro-incineration of the material in acid as a very considerable exchange of iron was found to take place between the solutions and the glass of the incineration tubes. The evidence suggested, however, that under the conditions employed the whole or nearly the whole of the iron was extracted by the acid.

It was found that non-blackening tubers could be made to blacken by soaking for some days in 1 per cent ferrous sulphate, washing away the excess and boiling. On exposure to air they developed a very dark greenish-black colour, similar to that found in ordinary blackening tubers, but more intense; this pigment also was rapidly bleached at *p*H 3·0. It was also observed that white ferrous hydroxide, precipitated from solution, gradually oxidized, passing through green to the magnetic black oxide.

This work, carried out during 1936–39 with the help of a grant from the Potato Marketing Board, had to be interrupted at the outbreak of war. Though much remains to be done it is suggested, as a tentative hypothesis, that in the raw tubers the precursor of the black pigment exists in the form of ferrous iron bound in a loose complex, possibly in combination with proteins. This complex is hydrolysed on boiling and the iron is then precipitated as a colourless ferrous compound, probably the hydroxide, which is gradually oxidized to the black oxide as air penetrates to the tissues. Although as yet supported by no direct evidence, this theory fits not only the facts established in the present work but also a number of hitherto unrelated observations of other workers in the same field, such as that of Tinckler[1] that the black pigmentation was induced in normal potatoes by contact with rusting iron during boiling, and the evidence obtained by Ross and Tottingham[2] that the proteins of blackening potatoes are more easily hydrolysable and autolysable than those of normal tubers.

I should like to thank Prof. V. H. Blackman for his advice and criticism throughout the course of this work.

URSULA M. ROBISON.

Research Institute of Plant Physiology,
Imperial College of Science and Technology,
South Kensington, S.W.7.
June 2.

[1] *Biochem. J.*, **25**, 773 (1931).
[2] *J. Agric. Res.*, **57**, 453 (1938).

Plagiophyres in an Intrusion at Downpatrick

IN 1937 B. C. King[1], in a petrographical examination of some Caledonian hypabyssal rocks from Kirkcudbrightshire, recorded the occurrence of plagiophyres in the dyke assemblage of this area.

Recent examination of a small intrusion at Slievenagriddle, two miles east of Downpatrick in Northern Ireland, has resulted in the discovery of this rock-type in the hypabyssal phase of the Newry 'granite' mass. The intrusion was originally recorded by the Geological Survey of Ireland[2], and on macroscopic examination was described by the Survey as syenite. In thin section the rock is seen to correspond closely to the Scottish plagiophyres; mafic minerals being entirely represented by chlorite, felspar and albite-oligoclase, abundant secondary calcite, etc.

Dykes of this Irish suite have been described from the Ards Peninsula[3] and the Killough-Ardglass coast[4], and are dominantly lamprophyric in these two areas. It is probable that further examination of this dyke-swarm towards the south-west (and the Newry 'granite') will reveal a more extensive variety of rock types than are at present known from the County Down area.

EDWARD M. PATTERSON.

Department of Geology,
Queen's University,
Belfast.

[1] King, B. C., *Proc. Geol. Assoc.*, **48**, 282–306 (1937).
[2] *Mem. Geol. Surv. Ireland*, Sheets 49, 50, 61, pp. 15 and 47.
[3] Reynolds, D. L., *Geol. Mag.*, **63**, 97–111 and 145–165.
[4] Tomkeieff, S. I., and Marshall, C. E., *Quart. J. Geol. Soc.*, **96**, 321–338.

Specific Heat of β-Brass

MY previous theoretical work[1], based on a method of approximation, has been criticized by Bethe and Kirkwood[2]. I have now carried out a rigorous evaluation of the partition function at constant volume, starting first with the two dimensional quadratic lattice.

Three partition functions are calculated successively, namely, $P(1)$, $P(n)$ and $P(n^2)$ which refer to: a square of four atoms, the 'elementary cell'; a ladder consisting of n elementary cells joining in one dimension; and the whole lattice, which consists of n ladders joined together with their lath.

$P(1)$ is a sum of eight terms according to the eight possible configurations of the cell. In order to account for the statistical correlations of the cells (the long-range order effect), the terms of $P(1)$ are considered to be the coefficients of a certain quadratic form in two variables and $P(n)$ to be the n-fold iterated quadratic form. Similarly, the terms of $P(n)$ are considered to be the coefficients of a quadratic form in 2^n variables and the n-fold iterated form to be equal to $P(n^2)$. In these calculations the form in a large number of variables is reduced to a product of forms in two variables.

In the limit, $n \to \infty$, $P(n^2)$ is found to be equal to $[p(x, y)]^{n^2}$ where $y = x = \exp(-\varphi/kT)$ and φ is a constant of the dimension of an energy. The mean energy is equal to $\varphi y \partial \log p/\partial y$. The function $p(x, y)$ has the following form:

$$p(x, y) = \tfrac{1}{2}\{(1 + y)[(1 - x^2)^2 + 8x^2(1 + y) + (1 - x^2)\sqrt{1 + 14x^2 + x^4}] + \sqrt{2}[(1 - x^2)^4(1 - y)^2 + 32x^4(1 + 14y^2 + y^4) + 8x^2(1 - x^2)^2(2 - 3y + 8y^2 + y^3) + ((1 - x^2)^3(1 - y)^2 + 8x^2(1 - x^2)(1 - y + 7y^2 + y^3))\sqrt{1 + 14x^2 + x^4}]^{1/2}\} \cdot [(1 + 14x^2 + x^4) + (1 - x^2)\sqrt{1 + 14x^2 + x^4}]^{-1}.$$

It is independent of n and has no singularity. The specific heat curve has a broad maximum which has no resemblance to a λ-point.

The method applies to a lattice in three dimensions, and calculations are in progress.

R. EISENSCHITZ.

Davy Faraday Laboratory,
Albemarle Street,
London, W.1.
May 28.

[1] *Proc. Roy. Soc.*, A, **168**, 546 (1938).
[2] *J. Chem. Phys.*, **7**, 578 (1939).

Metallic Triazine Complexes

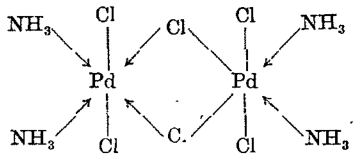
IN a recent note[1] referring to the palladium derivatives of diazoaminobenzene and of 4:4′-dimethyl-diazoaminobenzene described by Dwyer[2], it was stated that these compounds, containing one palladium atom united to three diazoaminobenzene units, "appear to be the first examples of hexacovalent palladous compounds [to be] described", this statement being made also by Dwyer in his original paper.

Actually, however, I have described the first such compounds[3], having prepared both platinous and palladous salts of αβγ-triamino-propane, the palladous derivative having the formula

$$[\{NH_2CH_2CH(NH_2)CH_2NH_2\}_2Pd]I_2.$$

Evidence was adduced to show that in such compounds all the amino-groups were coordinated to the metal, which was therefore undoubtedly hexacovalent.

Apart from this certain case, it is probable that the black crystalline compound[4] of empirical formula $(NH_3)_2PdCl_3$ has the constitution shown, containing one hexacovalent palladous and one hexacovalent palladic atom, bridged by the two chlorine atoms[5]. In this case the compound would exist as a resonance hybrid, and this factor is probably intimately associated with the colour of the crystals.



Dr. Dwyer's paper contains many interesting points. It is particularly noteworthy that the *tris*-diazoaminobenzene-palladium readily lost a molecule of diazoaminobenzene, and that the *bis*-diazoaminobenzene-palladium so formed could not be converted back to the original *tris*-derivative. This is not unexpected. The *bis*-derivative, having undoubtedly the planar configuration, could not undergo simple union with a third molecule of diazoaminobenzene, since the latter molecule would be unable to span the 1 : 6 position of the potential hexacovalent octahedron. The union would therefore be a complex process leading to an unstable compound, and hence does not apparently occur. I have discussed other cases of this phenomenon elsewhere[6].

F. G. MANN.

University Chemical Laboratory,
Cambridge.

[1] NATURE, 147, 612 (1941).

[2] *J. Amer. Chem. Soc.*, 63, 78 (1941).

[3] *J. Chem. Soc.*, 892 (1928); 654 (1929).

[4] Drew, Pinkard, Preston and Wardlaw, *J. Chem. Soc.*, 1898 (1932).

[5] Mann and Purdie, *J. Chem. Soc.*, 881 (1936).

[6] *J. Chem. Soc.*, 412 (1933).

Textures of Clays

PROBABLY the best method of evaluating the texture of a clay is to slake it up with water or break it up into its component parts by some method such as alternate drying and slaking, and then to size by combined sieve and pipette or hydrometer analyses. If this in turn is combined with microscopic examination, the grain shapes can be determined and an accurate conception can be obtained of the grain size distribution. The more detailed this size analysis the more valuable it is. However, without the mineralogical composition, the picture of the structure and texture is very incomplete. To quote an extreme case, a kaolin consisting of particles 95 per cent less than 43 microns and the main mineral, being kaolinite, may be only slightly plastic, whereas another clay having about 50 per cent of its particles less than 43 microns in diameter but containing water-swelling minerals of the montmorillonite group may be very plastic and have a very high modulus of rupture as well.

To take two examples, the mechanical analyses were as follows :

	1	2
Coarse sand	4·30	nil
Fine sand	24·80	1·23
Silt	35·60	37·90
Clay	28·80	61·12
Moisture	3·57	0·05
	97·07	100·30

1. Red clay from Port Elizabeth.
2. Washed kaolin from George, Cape Province.

At first glance one would be inclined to say that the second specimen would be the more plastic. Actually the kaolin is practically non-plastic although it is not hard and compact. The first sample contains some vermicular kaolinite, but is mainly composed of ferruginous clay minerals and illite. The second is composed almost wholely of kaolinite with some quartz. The kaolinite is platey and there is a high degree of coarse crystallinity. The first clay has a modulus of rupture of 390 lb./sq. in., whereas the value for the kaolin is less than 10 lb./sq. in.

Actually this type of analysis is not discriminating enough, and in later work the conventional size separates used by soil scientists was abandoned. The sub-sieve sizes were then dealt with in the following manner :—43–31, 31–16, 16–11, 11–5·5, 5·5–2·0, 2·0–1·0 microns, or as the texture of the clay varied. The method is flexible and the ultimate aim is to get the size distribution of the clay, rather than to fit the clay to a conventional nomenclature. If it is desired to compare the size distribution of two or more clays this can be best done graphically.

A problem that has not been solved is the condition of the organic phases[1]. The organic compounds are, with the exception of grass roots, etc., always associated with the finest sizes. That plasticity, green strength and other physical properties are influenced by the presence or absence of the peaty substances present in certain fireclays, kaolins and bog clays is evident from an examination of such rocks. In the case of a certain sedimentary kaolin, certain phases of the same clay contained organic matter and others did not. The difference in plasticity was striking.

V. L. BOSAZZA.

University of the Witwatersrand,
Johannesburg.

[1] Bosazza, V. L., NATURE, 144, 835 (1939).

Sense of Hearing in Fishes

I AM sure that the fish described in Dr. C. B. Williams' communication[1] did hear the bicycle bell, as a disturbance of the norm to which it is 'conditioned'. Dr. Bull has had to make a sound-proof room for his experiments at Cullercoats on the behaviour of blennies, etc.[2]

But the simplicity of the inner ear of fish, in which there is only an otolith floating in a saccule to serve instead of the graded tuning-forks of the mammalian cochlea, allows us to expect most fish to be rather hard of hearing, except in examples where we know to the contrary. The degree of hearing must vary from species to species, because the acoustic region of the brain shows varying degrees of development, even within one family ; and some fish have well-developed 'aids to the deaf' made from part of the swim bladder, for example, in carp and herring. All this, and more, is to be found in Dr. H. Muir Evans's recent book[3]. Dr. Evans's researches show that fishes have more elaborate organs of reception and perception than the text-books have led us to suppose. Sight, hearing and taste may all be well developed, and in varying degrees, and in a few species there is a genuine under-water voice.

MICHAEL GRAHAM.

Fisheries Laboratory,
Lowestoft.
May 9.

[1] NATURE, 147, 543 (1941).

[2] Dove Rep. (1934).

[3] "The Brain and Body of Fish" (Technical Press, 1940)

RESEARCH ITEMS

Changes in Amputated Nerveless Limbs of Urodele Larvæ

O. E. Schotté and E. G. Butler described the above morphological changes in a paper read on April 29 at the annual meeting of the U.S. National Academy of Sciences. By repeated resections of the brachial plexus, fore-limbs of Urodele larvæ have been maintained in a nerveless condition for several weeks, and in some cases for as long as two months. A limb, completely devoid of spinal innervation, not only loses its capacity for regeneration, but also, after amputation, it undergoes radical morphological changes. Beginning at the level of amputation and proceeding proximally, structures of an amputated nerveless limb undergo regression and resorption. This structural regression brings about extreme reduction in size and eventually complete disappearance of the limb. Histological studies demonstrate that the regression is the result primarily of cellular dedifferentiation. All formed structures of the limb, including skeleton and muscles, go into extreme dedifferentiation and gradually disappear. Moreover, dedifferentiation in a nerveless limb involves not only those structures injured at the time of amputation, but also those remote from the amputation level. Articulations do not serve as barriers to the dedifferentiative processes. These radical morphological changes are not the result primarily of physiological atrophy, but represent alterations in the specific character of limb tissues, caused by the disturbed unrolling of regenerative processes. Since control experiments show that denervation alone only impedes further growth processes, but is not followed by regression of structures, the above results reveal the importance of amputation for the normal course of regeneration. Unamputated nerveless limbs exhibit no dedifferentiation; amputated nerveless limbs show extreme dedifferentiation and reduction, leading to eventual disappearance of the limb. The nervous system, therefore, formerly regarded as exerting primarily a trophic influence on cellular activities during regeneration, must now be considered as an important agent of the organism as a whole, enabling amputated limbs to carry on the complex cellular interactions for regeneration.

Field Properties of the Developing Frog's Egg

EXPERIMENTAL observations on these properties were described by H. S. Burr, on April 29, at the annual meeting of the U.S. National Academy of Sciences. Some six thousand determinations were made on fifty frogs' eggs prior to the development of the long axis of the embryo as seen in the appearance of the medullary plate. Potential differences between the vertex of the animal pole and four equidistant points on the equator of the egg were measured by the Burr–Lane–Nims technique. Three variations in the technique were employed and all were subjected to statistical analysis. From the very beginning it was apparent that at least one of the four points showed a significantly greater voltage drop from the vertex than any of the other three. This point was then marked either by staining by Nile Blue sulphate or by the establishment of orientation points in the immediate environment of the egg. Of the fifty embryos, ten were marked successfully and developed to the neural plate stage. In the remaining forty, correlations were either not attempted or were impossible because of technical difficulties. It should be noted that the technique is rigorous and requires great care in its manipulation, and technical artefacts therefore frequently creep into the study. In every case where correlations were possible, the primary axis of the organism came to lie along the plane which showed the greatest voltage drop from the vertex. In other words, it was possible to predict from the voltage pattern where the head end of the organism would develop. It is hard to escape the conclusion, therefore, that the electrical pattern is primary, and, in some measure at least, determines the morphological pattern. Added weight is given to the argument by other observed facts.

Effects of β-Naphthoxyacetic Acid on Plants

P. W. ZIMMERMAN described some studies of this subject on April 28 at the annual meeting of the U.S. National Academy of Sciences. Many growth substances have in common the capacity of inducing similar responses in plants; that is, they cause cell elongation, increase cell division, and induce adventitious roots. There are, however, many qualitative differences in the capacity of chemically similar compounds to induce physiological responses. For example, β-naphthoxyacetic acid and its derivatives modify the new organs (leaves, stems, flowers and fruit) which are formed after the growing points are treated with the substance. The pattern and venation of compound leaves become modified, appearing frenched and fasciated. Leaflets frequently grow together on portions of compound leaves. Compound types sometimes become simple leaves and again doubly compound. Both the pattern and opaqueness of veins are modified. Veins of modified leaves show clearing which is usually characteristic of virus-diseased plants. Tobacco plants sprayed at the tip with a solution (300 mgm./l.) of β-naphthoxyacetic acid grow taller and flower ahead of controls. Treated delphinium plants also flower ahead of controls. Unless plants are re-treated at intervals they recover and again produce normal leaves and flowers. Parthenocarpic development of tomato fruit is induced when flowers or well-developed buds are sprayed with emulsions or solutions of naphthoxyacetic acid. The ovaries often enlarge before the flowers open, eventually breaking through on one side of the calyx tube. The floral parts—petals, stamens and pistils—persist for an abnormally long time during parthenocarpic development. In some cases both petals and stamens remain in good condition for 30 days whereas controls wither within 3 days after the flowers open. Compared with other growth substances, naphthoxyacetic acid has several advantages for practical production of seedless tomatoes and possibly of other fruits.

Biotin and the Growth of *Fusarium avenaceum*.

THE effect of biotin on the growth of *Fusarium avenaceum* was described in a paper by W. J. Robbins read on April 28 at the annual meeting of the U.S. National Academy of Sciences. A strain of *Fusarium avenaceum* obtained from South America does not grow in a solution of mineral salts and sugar but grows in the same solution solidified with agar. The beneficial effect of agar on the growth of this organism is chiefly because of biotin (vitamin H) present in the agar. Purification of the agar by extraction with aqueous pyridine removes the biotin and makes the agar ineffective in permitting growth of the fungus. The amount of biotin present varies with the sample of agar, but approximates to 0·1 microgram per gram in some samples. This is as much or more than is present in dried egg yolk. Agar was more beneficial than could be accounted for by its biotin content. A beneficial effect of 0·001 microgram of pure biotin (obtained from Dr. Vincent du Vigneaud) on the growth of the Fusarium in liquid culture was observed and amounts of biotin up to 0·1 microgram per culture further increased the dry weight. Some isolations made from old cultures of the fungus grew in the absence of biotin; these were interpreted to be saltations or dissociations.

Nitrogen/Phosphorus Relations in Lemon Seedlings

IN a paper read before the Royal Society of South Africa on March 19, J. W. Pont discussed the nitrogen–phosphorus relations in Rough lemon seedlings. No negative correlation between nitrogen and phosphorus could be observed in either the leaves, the stems or the roots. A positive correlation between nitrogen and phosphorus existed in the roots only. Roots, stems and leaves form distinct metabolic systems, and it appears plausible to accept that fruits form a separate system.

Drainage of the Fens

THE problem of the disposal of the Ouse floods and the Fen drainage has been much to the fore since the heavy floods of a few years ago. The various schemes that have been suggested are described and discussed by W. E. Doran in a paper on the Ouse flood problem in the *Geographical Journal* of April. Perhaps the most striking of the various proposals is that by Sir Murdoch MacDonald and Partners. This entails intercepting the upland waters in the headstreams of the Ouse and preventing them passing through the Fen area. It would involve the construction of a circular canal to the east of the Fens from the Cam at Grantchester via the Lark, the Little Ouse and the Wissey, at Stoke Ferry, to Denver, whence a new canal, suggested also by other authorities, would carry the water roughly parallel with the Ouse but more direct, to the main river at St. Germans. It is only as high up the Cam as Grantchester that a suitable level for the flow of water down this channel could be reached. Hence the impossibility of beginning it below Cambridge. Further details of the scheme, and the location of sluices and pumping stations, are explained in the paper and its accompanying map.

Divisions of the Pleistocene

THE correlation of Pleistocene deposits throughout the world presents many difficulties. In a paper on this subject (*Trans. Roy. Soc. Edin.*, 60, Part II, No. 11) T. T. Paterson points to the imperfection of the fossil record, the shortness of the whole period and consequent difficulty of subdivisions based on faunal development, and largely, the stress that has been laid on different phenomena in studies of the period in different lands. He surveys the available evidence from a wide area, examining especially the fluviatile deposits, and he amplifies the scanty fossil record by the use of palæolithic horizons. To these he pays particular attention and gives a survey of culture development during the period. Paterson concludes that variations in power-volume, the result of combined orogenic and precipitational changes, are coincident throughout the Old World. The variations result in three great cycles of sedimentation divisible into seven phases. The first, second and third glacial episodes coincide with the beginning of each cycle, and the fourth with the third phase of the last cycle. The fifth glacial episode marks the end of the Pleistocene. It is proposed to divide the Pleistocene into Lower, Middle and Upper, with seven phases termed L_1 L_2 M_1 M_2 U_1 U_2 U_3, to show their relationship with the three major subdivisions (see also NATURE, 146, 12–15 and 49–52; 1940). In a discussion on the causes of power-volume changes, Paterson concludes that G. C. Simpson's theory of variation in solar radiation explains most of the phenomena.

Electrophoretic Study of Complexes between Proteins, etc.

D. A. MACINNES and L. G. Longworth described some experimental work in the above connexion before the annual meeting of the U.S. National Academy of Sciences, on April 29. In their study of egg white, by a modification of the method of Tiselius, evidence was obtained that complexes exist between the proteins in the naturally occurring material and also in salt and buffer solutions. The evidence comes largely from the fact that in certain cases the electrophoretic patterns for the rising and descending boundaries are not, even approximately, mirror images of each other, as would be expected if the components were electrophoretically independent. The effect is greatest for relatively high protein concentrations and low salt contents of the solutions used in the studies. Complexes are most often found between proteins on opposite sides of their isoelectric points, but this is by no means a necessary condition for their occurrence. As type systems, electrophoretic studies have been carried out systematically on mixtures of ovalbumin and yeast nucleic acid, and on this nucleic acid with ovomucoid, varying the relative concentrations, the *p*H values and the ionic strengths. The electrophoretic pattern for a mixture of ovomucoid and nucleic acid is particularly interesting in that it indicates a peak for an extra component. The apparent relative concentrations, as indicated by the areas under the different peaks of the patterns, are altered by complex formation. With the mixture of ovalbumin and nucleic acid the components were found to form complexes if the *p*H were near or below the isoelectric point of ovalbumin, but to be electrophoretically quite independent at high *p*H values.

Temperature and Variations of Cosmic-Ray Intensity

THE correlation between the seasonal variations of cosmic-ray intensity and temperature of the atmosphere are examined by A. Duperier (*Proc. Roy. Soc.*, A, 177, 204; 1941) using data for Europe and the United States. A lag in the warming of the atmosphere in spring is found to be paralleled by a lag in the diminution of intensity of the cosmic rays. The correlation is closer with the mean temperature of the atmosphere up to 16 km. than with temperature near the ground. The temperature coefficient of the cosmic rays as deduced from the seasonal data is 0·18 per cent per degree C., in rough agreement with theory.

ÆSTHETIC APPEAL OF OSTWALD'S CHROMATIC STANDARDS

By Dr. J. B. Parry
University College, London

In Nature of May 31, p. 682, Dr. H. J. Eysenck has examined a number of claims made by Ostwald for his colour system. It may be of interest to put on record two experiments I have recently carried out relating to the æsthetic appeal of Ostwald's chromatic circles; the first deals with the appeal of single hues, the second with that of triple combinations. The detailed account of the experiments will be found in my Ph.D. thesis (London, 1940) entitled "The Rôle of Attention in Æsthetic Experience".

Preferences for Single Hues

It is desirable to explain that, according to Ostwald, the physical composition of any colour stimulus may be shown by an equation of the form: Hue+Black+White = 1. Circles, known as isovalents, can be defined, for any one of which the same equation holds for all its members, only the hue quality varying from one member to another. A condensed formula for each circle is given by two letters, the first indicating the proportion of white content, the second that of black content. There are of course many tint circles ranging from near white to near saturation and many shade circles from near black to near saturation; those selected here are intermediate.

The materials for the first experiment were twenty-four Ostwald papers cut to the size of 3½ in. square and backed with stiff cardboard. The selection comprised three sets of eight items each, the first containing fully saturated hues (circle *na*), the second tints (circle *ga*) and the third shades (circle *ng*). In each set the middle values of the eight principal hues were chosen. Fifteen educated persons were asked to grade these items according to preference by linear ranking, the test being performed in daylight against a background of white blotting-paper.

Factorial analysis of the resultant intercorrelations of persons by simple summation revealed a first factor responsible for 26·5 per cent of the variance. From this it seems clear that there is a strong tendency to general agreement as to the pleasantness or unpleasantness of single hues.

The relative popularity of the individual items may be estimated by summing the positions allotted to each by the fifteen subjects. From the resultant order of popularity of twenty-four items one can of course abstract an order of popularity for the eight hues in each of the three circles. These latter orders are shown in the following table, the figures in brackets showing the positions of the items in the order of popularity of all twenty-four items.

Order of Popularity of the Items in the Three Circles

Circle Hue	*na*	(Full Saturation)	*ga*	(Tints)	*ng*	(Shades)
Yellow	7	(20)	8	(18)	8	(24)
Orange	6	(15)	7	(22)	6	(17)
Red	1	(1)	4	(9)	4	(13)
Purple	5	(14)	6	(21)	5	(16)
Ultramarine	2	(2)	3	(8)	1	(7)
Turquoise	4	(6)	1	(3)	7	(19)
Sea Green	3	(4)	2	(4)	2	(11)
Leaf Green	8	(23)	5	(10)	3	(11)

The high positions of all three ultramarines and sea greens and the marked unpopularity of the oranges and yellows will be noted.

Preference for Triple Combinations

Ostwald makes two specific claims regarding the appeal of triple combinations: first, that membership of the same circle is a condition favouring harmony; secondly, that among terms fulfilling this condition, equality in the psychological intervals between the terms is a further favouring condition (this second claim rests on the assumption that the intervals between successive terms on any Ostwald circle are all psychologically equal); this point was one of many investigated by Prof. C. Burt a number of years ago—he reached the conclusion that the intervals were often far from equal, an opinion also expressed by Eysenck in his recent article in this journal.

In framing the following test Ostwald's claims were borne in mind. The materials for this second test consisted of 24 triple combinations, comprising four groups:

(1) Eight equally spaced combinations from the standard hue circle *na* (for example, 1, 9, 17; 7, 15, 23, etc.). In this group both the above conditions are realized.

(2) Eight unequally spaced combinations from the standard hue circle, each of the four possible degrees of inequality being represented twice (for example, 1, 16, 17; 2, 15, 18; 3, 14, 19; 4, 13, 20). In this group the first of the above conditions is realized, the second is violated.

(3) Four equally spaced combinations, the three terms of each combination being drawn from three different circles, namely, the standard hue circle *na*, a tint circle *ia*, and a shade circle *ne*. Here the first condition is violated and the second observed.

(4) Four combinations (two equally spaced, two unequally spaced) from a grey shade circle *ie*.

Fourteen persons, all but one adult, were asked to award marks to groups of these on the principle: 8 marks to the one liked best, 7 to the next best, 6 to each of the next three . . . 0 to the one liked least. The test was carried out in daylight against a background of ordinary newsprint. Factorial analysis showed a first factor covering 31·66 per cent of the variance and a significant second factor accounting for a further 22·81 per cent.

The most impressive fact revealed by inspection of the preferences is that the seven subjects whose rankings approximate most closely to the average order have accorded maximum marks to the four greyed combinations; of the remaining seven, five have placed the members of this group slightly lower than midway, one has marked them very high and one very low. But this preference does not entirely account for the first factor discovered.

The four combinations with very unequal intervals were found extremely unpleasing by all but one of the subjects. This appears at first to support Ostwald's contention that the basis of harmony is equality of spacing; when, however, we compare the marks allotted to the equally spaced combinations with those that show a moderate inequality we find no further confirmation of the claim. As for the claim that membership of the same circle is a condition favouring harmony, the evidence at our disposal points, if anything, the other way.

Since no amount of inspection enabled me to discern the nature of the second factor, I decided to carry out a second test removing the four greyed combinations and the three least popular of the unequally spaced combinations. I then asked a dozen people (ten of whom had done the previous test) to range the remaining seventeen combinations by linear method. The results brought to light a truly dominating bipolar factor. Inspection of the items most diversely judged reveals two characters that it is easier to perceive than name. Some idea of the characters may possibly be indicated by pointing out that the leading members of one set each contained a pale green and a pale red, while those of the other set contained orange-yellows and deep greens. What is of special psychological interest is that no trace of this factor can be seen in the results of the original test, in which, of course, all the seventeen items were included. It appears that before these characters could be attended to, other more striking qualities such as greyedness and wide inequality of interval had to be eliminated. Once this has been done, these characters carry all before them.

In these tests of triple combinations, the three terms in each item were made to cover equal areas. This, of course, made it improbable that anything like the most pleasing combinations were reached. To achieve this result many more experiments would be necessary, and I hope in due time to carry these out. But the relative unpleasantness of the items in the tests so far done has not made it impossible to discern some of the principles influencing subjects in their assessment of the relative merits of colour combinations. What stands out with especial clearness is the complexity of the problem of colour harmony; any attempt, like Ostwald's, to explain it by a single principle seems foredoomed to failure.

THE BONE-BEARING BEDS OF BETHLEHEM

THE excavation of the bone-bearing beds of Bethlehem was undertaken by the Wellcome Archæological Expedition to the Near East under the auspices of the Department of Antiquities, Palestine, and work was carried on for three seasons (1935–7) with E. W. Gardner as geologist and D. M. A. Bate as palæontologist. The continuation of the work in 1937 was made possible through the support of the trustees of the late Sir Henry Wellcome, and of the late Sir Robert Mond. A preliminary account of the results was published in NATURE of September 4, 1937.

No work was done on the site in 1938 or 1939, but last year (1940) the co-operation of Dr. Stekelis of the Hebrew University was enlisted to complete the excavation so far as possible. His report has now been received and shows that some notable results have been achieved. In the area from which specimens had already been obtained, work was continued to a depth of several metres below the last occurrence of animal remains, but it was not possible to test the horizontal extent of the bone bed. The geological and archæological finds do not seem to provide very definite or final evidence regarding the history, or the possible human occupation of the site, but an interesting suggestion is made by Dr. Stekelis that a number of split bones collected may have been worked by man. A detailed study and comparison of these specimens should prove of exceptional interest.

A considerable quantity of animal remains was obtained, and the specimens will be sent in due course to the British Museum (Natural History) for study and description, together with those of the earlier collections. Dr. Stekelis's list shows that at least six species are recognized; they are as follows:

Bos sp.
Antelope
Equus sp. (? Hipparion)
Rhinoceros sp.
Elephas sp.
Testudo sp.

A number of valuable specimens were recovered and these include a mandibular ramus with teeth, and an almost complete skull with cheek teeth of Rhinoceros; Elephas or Stegodon is represented by a ramus with molars, as well as by isolated teeth and limb bones. Portions of jaws with teeth of antelope, and various remains of ox are also present. All these should be of value not only for determining the species, but also in interpreting the geological age and the relationship and status of this very interesting fossil fauna.

D. M. A. B.

VELOCITIES OF EARTHQUAKE WAVES

FRANCIS BIRCH has published a paper entitled "The Variation of Seismic Velocities within a Simplified Earth Model, in accordance with the Theory of Finite Strain" (Paper 55, Geophysical Research, Harvard University), which marks a somewhat new direction for seismological research.

The author states that the treatment of many problems concerning the elasticity of the earth as a whole has been handicapped by the lack of an adequate theory of finite deformation, which would permit quantitative estimation of the effects of the initial strain of the material below the surface. While certain artifices which have been employed to evade this difficulty have had the merit of adding a sufficient number of conditions to allow the solution of various special problems, they have proved incapable of answering such fundamental questions as "Given a layer or a spherical shell of perfectly elastic (not incompressible) material, isotropic, homogeneous, and at uniform temperature, to find the variation of density and of the velocities of elastic waves due to self-compression in a gravitational field". Answers to these questions may naturally be sought in the results of high-pressure experiments, but at best the pressures realizable in the laboratory correspond to small depths in relation to the earth's radius.

A theory which will allow quantitative prediction of the effect of pressure upon density and elasticities can evidently be of great assistance in dealing with the vast region which will probably always remain beyond the range of experimental technique. In the opinion of Mr. Birch, a theory of this character has recently been provided by F. D. Murnaghan ("Finite Deformations of an Elastic Solid", *Amer. J. Math.*, **59**, 235–260; 1937), and Birch applies the theory to a study of the density and velocity variations in a simplified model of the earth outside the core, consisting of two homogeneous layers at uniform temperature. The layers are separated by a first order discontinuity at a depth of 474 km. (after Jeffreys). The velocities obtained are in fair agreement with those obtained by Jeffreys and Bullen, and the variations of density are very similar to those derived by Jeffreys and Bullen by numerical integration of the 'observed' velocities, on the supposition of adiabatic compression of homogeneous layers. The validity of their method is shown to depend upon the existence of a small temperature gradient, or of compensating factors which cannot be evaluated. It is suggested that a more rigorous solution of the equations of motion derived from the theory of finite strain might prove of value in interpreting the oscillatory character of seismic records, as well as the direction of the ground motion associated with various wave types.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

DEPUTY DIRECTOR OF EDUCATION—The Director of Education, Education Office, St. Helens (endorsed 'Deputy Director of Education') (June 27).

DEMONSTRATOR in the Department of Zoology—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (June 28).

ASSISTANT to the Engineer-in-Chief—The General Manager and Secretary, Mersey Docks and Harbour Board, Dock Office Liverpool (June 30).

PROFESSOR OF PHYSIOLOGY at the London (Royal Free Hospital) School of Medicine for Women—The Academic Registrar, University of London, Royal Holloway College, Englefield Green, Surrey (July 1).

AGRICULTURAL MARKETING ADVISER to the Government of India—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (July 2).

ASSISTANT DIRECTOR OF EDUCATION—The Director of Education, Education Office, Becket Street, Derby.

FORTHCOMING EVENTS

Monday, June 23

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 3 p.m.—Annual General Meeting. (Presidential Address.)

Tuesday, June 24

ROYAL ANTHROPOLOGICAL INSTITUTE of Great Britain and Ireland (at 21 Bedford Square, London, W.C.1), at 2.30 p.m.—Annual General Meeting. Prof. A. R. Radcliffe-Brown: "The Study of Kinship" (Presidential Address).

REPORTS AND OTHER PUBLICATIONS

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Empire Cotton Growing Corporation. Progress Reports from Experiment Stations, Season 1939–1940; Programmes of Experiments, Season 1940–1941. Pp. vi+176. (London: Empire Cotton Growing Corporation.) [235

River Flow Records of the River Moriston at Invermoriston for the Water-Years ending respectively on September 30th of 1938, 1939 and 1940. By Capt. W. N. McClean. Pp. 10. (London: River Flow Records.) [265

The Zoological Record. Vol. 76: Being Records of Zoological Literature relating chiefly to the Year 1939. Compiled for the Zoological Society of London by A. G. Brighton, M. Burton, A. B. Hastings, C. A. Hoare, W. Nicoll, A. E. Salisbury, J. K. S. St. Joseph, W. L. Sclater, M. A. Smith, C. J. Stubblefield, E. Trewavas, E. I. White, R. J. Whittick, and the Imperial Institute of Entomology. Edited by Malcolm A. Smith. Pp. 1420. (London: Zoological Society of London.) £3; also issued in 19 separate Sections. [285

Other Countries

Government of India Industrial Research Bureau. Report for the Year 1939–40. Pp. iv+40+2 plates. 1.2 rupees; 1*s*. 9*d*. Bulletin No. 19: Indian Vegetable Oils as Fuels for Diesel Engines. By H. D. Chowdhury, S. N. Mukerjee, J. S. Aggarwal and Dr. Lal C. Verman. Pp. iv+28+7 plates. 1.6 rupees; 2*s*. (Delhi: Manager of Publications.) [205

Occasional Papers of the Bernice P. Bishop Museum. Vol. 15, No. 28: *Ophioglossum*, *Rollandia* and *Scaevola*. By Harold St. John. (Hawaiian Plant Studies, 9.) Pp. 351–360. Vol. 15, No. 29: Plant-parasitic and Free-living Nematodes in Hawaii. By J. M. Oliveira. Pp. 361–374. Vol. 16, No. 1: New Species of Dicotyledonous Spermatophytes from Tahiti. By John W. Moore. Pp. 24. Vol. 16, No. 2: A Revision of the Hawaiian Species of Myrsine (*Suttonia*, *Rapanea*), (*Myrsinaceae*). By Edward Y. Hosaka. Pp. 25–76. Vol. 16, No. 3: Three Polynesian Ferns. By E. B. Copeland. Pp. 77–80. Vol. 16, No. 4: Itinerary of Hugh Cuming in Polynesia. By Harold St. John. Pp. 81–90. Vol. 16, No. 5: New Species and New Records of Elaterid Beetles from the Pacific. By R. H. Van Zwaluwenburg. Pp. 91–130. Vol. 16, No. 6: Coleoptera from the Caroline Islands. By K. G. Blair. Pp. 131–158. Vol. 16, No. 7: Report on a Collection of Samoan Coleoptera. By Elwood C. Zimmerman. Pp. 159–176. Vol. 16, No. 8: A Revision of the Genus *Deretiosus* (Coleoptera, Curculionidae). By Elwood C. Zimmerman. Pp. 177–214. (Honolulu: Bernice P. Bishop Museum.) [215

Commonwealth of Australia: Council for Scientific and Industrial Research. Pamphlet No. 104: The Australian Tunas. By Dr. D. L. Serventy. (Division of Fisheries: Report No. 4.) Pp. 48+4 plates. Pamphlet No. 105: The Biology and Cultivation of Oysters in Australia. 1: Some Economic Aspects. By G. L. Kesteven. (Division of Fisheries: Report No. 5.) Pp. 32. (Melbourne: Government Printer.) [235

Transactions of the Academy of Science of St. Louis. Vol. 30, No. 4: The Agricultural Economy of the American Bottoms in Madison and St. Clair Counties, Illinois. By Prof. Mendel E. Branom. Pp. iv+90+143. (St. Louis, Mo.: Academy of Science of St. Louis.) [235

Astronomical Papers prepared for the Use of the American Ephemeris and Nautical Almanac. Vol. 10, Part 2: Catalog of 3539 Zodiacal Stars for the Equinox 1950.0. Pp. 167–300. (Washington, D.C.: Government Printing Office.) 30 cents. [265

Field Museum of Natural History. Geological Series. Vol. 8, No. 4: A New Fossil Alligator from Nebraska. By Karl P. Schmidt. (Publication 494.) Pp. 27–32. 10 cents. Zoological Series, Vol. 24, No. 20: Two New Birds from British Guiana. By Emmet R. Blake. (Publication 495.) Pp. 227–232. 10 cents. (Chicago: Field Museum of Natural History.) [265

Studies on the Microflora of the Dead Sea. By Benjamin Elazari-Volcani. Pp. xiii+121+17 plates. (Rehovoth: The Author, Daniel Sieff Research Institute.) [265

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), July to December 1939. (No. 806.) Pp. iii+116+2 plates. (Ottawa: King's Printer.) 25 cents. [275

Catalogues

Better Animal Health (Iodine Facts, 48–101). p. 25–52. (London: Iodine Education Bureau.) Free.

The Wild-Barfield Heat-Treatment Journal. Vol. 4, No. 28. Pp. 35–46+iv. (Watford: Wild-Barfield Electric Furnaces, Ltd.)

The Oertling Special Micro-Chemical Balance No. 63. PB. Pp. 6. (London: L. Oertling, Ltd.)

Cooke Vertical Comparator. (Publication No. 886.) Pp. 12. (London: Cooke, Troughton and Simms, Ltd.)

Automatic Control. (R/17.) Pp. 8. (London: Negretti and Zambra.)

A Catalogue of Books offered at very moderate prices selected from the Stock of Bernard Quaritch, Ltd.: Biblical and Liturgical Literature, Bibliography, Entomology, Music, Addenda. (No. 587.) Pp. 68. (London: Bernard Quaritch, Ltd.)

A Catalogue of Books on Zoology, Geology, and Palaeontology. (No. 588.) Pp. 36. (London: Bernard Quaritch, Ltd.)

Vitamins in Nutrition. Pp. 32. (Rahway, N.J.: Merck and Co., Inc.)

Cambridge pH Instruments. (List No. 108A.) Pp. 28. (London: Cambridge Instrument Co., Ltd.)

A List of Publications and Remainders. Pp. 16. (London: Bernard Quaritch, Ltd.)

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LE COQ D'OR

KING DODON was mighty anxious. His kingdom was threatened, yet though in his youth and prime he was a redoubtable monarch, he had long since ceased to care for warlike pursuits. Following the example of their monarch, the people too were contemptuous of the profession of arms, and their young men gave themselves up to pleasure.

The rulers of neighbouring domains were not slow in taking advantage of this state of affairs, so now here was King Dodon threatened with the dangers of invasion. In council, Prince Guidon advised his father. "The chief of our troubles," he said, "is that our enemy is so near to us that he is already about to fall upon our army and annihilate it. Let us, then, bring back our warriors from the borders and place them around our beloved capital to protect it and ourselves from harm."

All the company were delighted, except Prince Afron and the venerable head of the army, Polkan. They angrily opposed such a foolish plan. So King Dodon asked the advice of his son Afron who said: "Recall our soldiers just a month before the enemy attacks, and then we will go forth and crush him."

With all this conflicting advice, no wonder King Dodon was puzzled, and it is not surprising that disorder broke out in the company of the Council.

Then in the midst of this confusion there appeared at the top of the stairway a very old and venerable-looking Astrologer. He carried in one hand an astrolabe and in the other a bag. "Hail, King Dodon! Although thou knowest not me, yet art thou well known to me. . . . I have come to offer unto thee a magic remedy, so that thou mayest once more sleep in peace. . . . Accept my Golden Cockerel, O Sire, and place it upon the highest spire upon thy palace; and it shall be a true watchman unto thee. When all is peaceful and quiet, it will make no sound whatever . . .; but if enemies are about, or if thy peace is threatened in any way, then will my magic Golden Cockerel raise his comb, flap his wings, and turning in the direction from whence the danger appears, will crow aloud 'Cock-a-doodle-do! Beware!' "

That is how the story of Rimsky-Korsakov's pantomime-opera "Le Coq d'Or" opens. It does not tell us how old that Golden Cockerel was, nor for how many years the Astrologer had possessed it; but six years ago another 'Golden Cockerel' began to develop, and now, having proved its ability to call "Cock-a-doodle-do! Beware!" at the appropriate moment, it, together with its 'Astrologer', was introduced to the world by a Minister of State on June 18, 1941.

But there is nothing very new in this announcement and appeal, both at home and overseas, for radio engineers, physicists, etc., to play their part in helping the Cockerel to crow. That is, it is not very new to men of science. Radiolocation, in its origin, was the conception of one man, Mr. R. A. Watson Watt, C.B., F.R.S., scientific adviser on telecommunications to the Chief of the Air Staff, who, with his collaborators and assistants, aided it in its development from chick to adult. No; neither the Cockerel nor its Astrologer are very new to science, for Watson Watt's researches in radio engineering, especially while at the National Physical Laboratory and at the Bawdsey Research Station, have earned for him a world-wide reputation among men of science, and he is the author of many contributions which have appeared in our columns

The Astrologer said: "Although thou knowest not me, yet art thou well known to me." How true has that been in modern times. How pitifully few of the people, and especially of their leaders, have even bothered to examine what Science has to offer them; and how few are there who know, or express appreciation of, the work of Science behind all the advances—technical, biological, medical, etc.—of this age. It is necessary for national emergencies and modern 'Astrologers' to bring it all home to them. Lord Beaverbrook, on the occasion of the announcement of Watson Watt's great achievement, has now impressed it upon the people that "Technical developments make progress in war which sometimes outstrips all that has gone before. . . . It is the scientist who will heal our wounds. It is the scientist who will protect us against the loss of our life-blood. It is the scientist who will save our home and guard our hearthstones."

Thus on the basis of the work of Watson Watt, Sir Frank Smith and others, did the Minister of State make his call to service: "Man the front line of Science." No doubt men and women from all parts of the world will respond to the call, and thus will Science have made in an almost glamorous way another of her many contributions towards victory in war, for truly this is not only a war of machines—for that is only a part of the story; it is a war of Science, the science of defence, the science of living against great odds, and, alas, the science of destruction.

But what is to be the result of all this? What did the Astrologer demand in the end? He declared that the ordinary gifts of riches and high rank were as nothing to him, since he regarded love only as precious, and at the end of the story he demands the hand of the Queen of Shemakhan. So this is where modern Science and the ancient Astrologer must part company.

Through such men as Watson Watt, the people are learning the first-rate value of Science in modern warfare; so now let Science build up evidence for her claim for all-out recognition and for her just status in times of peace.

How often has this been emphasized in NATURE. But society has still to realize it fully. Even in medicine most people recognize only the medicine of disease. Either they do not recognize or they ignore the medicine of health. They recognize the work of a medical man only when, through illness, they need him. Little do they know of preventive medicine. So is it with Science. Science can be constructive as well as destructive. Which it is to be depends upon society. She offers us a good, strong, useful rope; is it her fault if we choose to hang ourselves with it? Science has played and will have to play, a very important part in the advancement of civilization and the improvement of social life. Little have men of affairs realized or recognized this in the past.

In his appeal, Lord Beaverbrook referred to "the hour when men of science can turn again to the thoughts and the labours of peace". The exigencies of war have constrained many men of affairs to recognize and to appreciate what Science has to offer. The War Minister, too, announced to the House of Commons on June 18 that there might be occasion for the appointment of a special scientific attaché to foreign Governments in view of what Lord Beaverbrook had said in his broadcast appeal. But Science offers more, much more, than weapons of destruction and materials for defence. She offers a horn of plenty, full of good, constructive ideas and machines. When the hour of peace comes, is she to be discarded as something only useful in confounding our enemies? Are Mr. Eden's attachés to be recalled? If so, then our men of affairs will prove to have been opportunists who have learned nothing.

Our Army, Air Force and Navy are in the front line of action. But there are many other fronts—our kitchens, gardens, farms and factories—and not least of all, Science. We have learned of the folly of neglecting our fighting forces in those times of peace when certain sections of the world were treating a period of peace as one of preparation for war. Until the world is ready for a real and lasting peace, we must bear that lesson in mind, once victory is achieved. This applies also to Science. Let her be recognized and encouraged in the everyday lives of the many; let her too be admitted to the council of the chosen few. Never let her be neglected or merely taken for granted again.

Men of science are becoming very conscious of their duty to society. Will society, in the peace to follow, recognize its obligations to Science and avail itself of all the good things that this war is proving Science has to offer? Men of science will be able to offer new and possibly strange tools to society; will society take them and tackle the job of building and maintaining the peace—a job infinitely more difficult than that of winning the war?

"The scientist will heal our wounds."

SOVIET RUSSIA

ON Sunday, June 22, the Nazi war machine was set in motion against Soviet Russia, without even the prelude of an ultimatum.

One by one the nations of Europe have been made subject to direct or indirect Nazi domination, and, with the failure of early attempts to break the resistance of the British Empire and the Free men of the occupied countries now fighting with us, and in apprehension of the effect of the growing weight of support from the United States, the Nazis have turned to the east in an attempt to seize the natural resources of Soviet Russia and to immobilize her armies. Beyond the immediate aims there is little doubt that the intention is to foment strife beyond Europe, in Iran, India and China, and elsewhere in Asia. It is all part of the gigantic scheme to dominate the world by terror and force, to subdue the peoples of all countries and to make them the slaves, body and soul, of Germany.

Mr. Winston Churchill drew a moving picture of the situation as he described it in a broadcast to the world on the evening following the invasion. "It is not too much to say, here this summer evening, that the lives and happiness of a thousand million additional human beings are now menaced with brutal Nazi violence. . . . The Nazi regime is indistinguishable from the worst features of Communism. It is devoid of all theme and principle except appetite and racial domination. It excels all forms of human wickedness in the efficiency of its cruelty and ferocious aggression." A vital decision had to be taken at once by His Majesty's Government, and there will be agreement everywhere with Mr. Churchill's announcement: "We have offered to the Government of Soviet Russia any technical or economic assistance which is in our power and which is likely to be of service to them." It matters not what political label be given for the time being to any nation or group of peoples; we cannot withhold our support from anyone who attempts to withstand the Nazi menace.

Soviet Russia has passed through many vicissitudes since it began to emerge from the Revolution of 1917. Internal difficulties have been numerous. There have been hardship and cruelty. But slowly, and with many hesitating moves, a system of government was built up which bound together the vast Russian territories in Europe and Asia into an organic whole. Some of us may not have sympathized with the ideological background which was developed; others have hailed the evolution of Soviet Russia as a symbol of the form of organized society towards which the nations should move. As Mr. Churchill said, all this must now be put aside. We are faced with an elemental fact. The Russian people now attacked are men and women. They have grown up with a measure of self-government. They have developed the industries of their country; education has been promoted; science and scientific research have received support. Institutes devoted to research have begun to function, as many communications published in NATURE from time to time until a few months ago have shown. Freedom of research as the English-speaking nations know it has not yet been achieved; nevertheless valuable work has been done. We need only recall in this connexion the names of the physicists Kapitza and Joffe, and of the geneticist Vavilov, all of whom have international reputations. These people are being attacked by the sworn enemy of democracy and all that it stands for: "Any man or State who fights Nazism will have our aid."

The attack on Soviet Russia represents, as Mr. Churchill put it, the fourth climacteric in this War; it was marked by "the same kind of outrage against every form of signed compact and international faith which we had witnessed in Norway, Denmark, Holland and Belgium". Freedom of thought leads to freedom of speech, one of the cardinal principles of democracy. This in turn requires the recognition by the individual of the rights and liberties of others; individual liberty must submit to restraints imposed by the needs of society. Such restraints may or may not be codified and become laws, but their observance is a condition upon which the continuance of human society depends. Similarly, in the field of international relationships, the rights of the several nations to their own modes of government must be respected, and the terms of solemnly pledged treaties must be honoured. It will be the task of men of all races, creeds and parties, so to work together after the War that law-breaking among the nations becomes impossible. Lawlessness in international affairs is inimical to the progress of civilization.

HOT SPRINGS AND GEYSERS OF ICELAND

On Thermal Activity in Iceland and Geyser Action

By Thorkell Thorkelsson. Pp. 139. (Reykjavík: Ísafoldarprentsmidja H.F., 1940.)

NOWHERE is thermal spring activity so intense and widespread as in Iceland; many thousands of hot springs are known and in addition many more exist beneath the glaciers and on the shallow sea floor. The lives of the springs vary from a day to hundreds of years. The large spring Reykjalaug is known to have existed in A.D. 1000 for it is reported in the "Kristni saga" that when at that time Christianity was adopted by Parliament the remaining heathen northerners rode to Reykjalaug to be baptized as they refused to suffer this in cold water. In recent years extensive works have been carried out to utilize the springs in heating houses, schools, hospitals and greenhouses and in the provision of public baths. There is a virtually inexhaustible store of energy in the hot ground waters and the future should see further extension of its service to man.

Many famous names are associated with the early study of thermal activity in Iceland; the work of Bunsen is perhaps the best known. No one has paid more attention to the subject than Thorkell Thorkelsson, and this memoir, which includes reflections based upon a life's study, is of prime importance; it is only unfortunate that the absence of sub-headings and somewhat rambling treatment of this long essay will deter some from reading it.

The springs occupy the site of historic volcanic activity and its neighbourhood, and there can be no doubt that the heat is of magmatic origin. With the pouring out of lava at the surface it is reasonable to suppose that a volume of magma remains to cool in the outer part of the earth's crust, and the ground waters are heated by contact with hot rock and by absorption of super-heated steam and other gases given off from the crystallizing magma. It is impossible to determine how much (if any) of the spring water is magmatic, but there is abundant evidence that the water is largely of surface origin—a geyser near the coast at Reykjanes delivers almost pure sea water. Outside the volcanic regions of recent date the gases other than water vapour emanating from the springs consist almost entirely (usually 98 per cent by volume) of nitrogen and argon, in similar proportions to those of the atmosphere, and it may be assumed that in these cases dissolved air has lost its oxygen by combination with the rocks. Within the volcanic region the prominent gases are hydrogen, carbon dioxide and sulphuretted hydrogen, and these are probably of magmatic origin.

Normally the heat is conveyed to the surface and dissipated continuously: only a very small proportion of the springs are geysers. In all likelihood the supply of heat at source is constant and the fundamental cause of geyser action is to be found in the circumstance that the heat acquired in depth cannot be carried away at the rate at which it is added, but accumulates until such instability results that the hot water is violently ejected. The time required for the heating up of the cooler water, then coming in to fill the channels and chambers of the geyser system, readily accounts for the intermittency of the eruptions: the main difficulty is to establish what causes the start of an eruption. Early theories are based on the conception of super-heating: the temperature is supposed to rise at some point until steam is formed with progressive fall of hydrostatic pressure and with consequent expulsion of the water. Observations, however, have not revealed the attainment of super-heat in depth, neither has a continuing increase of temperature been found in the quiescent intervals; if super-heat is attained it must be in greater and inaccessible depths.

Thorkelsson advances reasons for doubting any common development of super-heat; he sees in the spring gases the cause of most geyser eruptions, and cites examples of eruptions where the temperature was below 100° C. "even deep down in the subterranean channels". Gas bubbles are visible in most Icelandic springs and at high temperatures are largely composed of water vapour. "However, the spring gases in spite of their fractional smallness constitute a necessary condition for the existence of the bubbles. If the spring gases were removed the bubbles would collapse immediately."

The essence of Thorkelsson's theory is that swarms of gas bubbles form as the water rises, and the hydrostatic pressure of the gas and water mixture being less than that of water alone (the air-lift pump principle), a reduction of pressure results which may produce an uprush of water sufficient to start the eruption. With this the water will, in many cases, come to boil at the lower pressures experienced in its rise and steam will then play its part; but the fundamental cause of the uprush is considered to lie in the separation of the gas bubbles. It is significant that geysers have been converted into normal springs by putting stones in the channels to retard the flow, also that springs have been converted into geysers by the removal of channel obstructions.

No two geyser systems are the same; they differ in the number, size, form and attitude of the subterranean spaces. As the upper pipe open to investigation is only a small part of the system and, moreover, is not as a rule the site of the development of the expulsive force, it is not surprising that no general theory can be formulated to cover all cases; the statement by Day and Allen in their work on "The Hot Springs of the Yellowstone National Park" (1935) that in their experience the permanent gases are extremely scarce in geysers generally must not be forgotten. L. Hawkes.

BIOLOGICAL FIXATION OF NITROGEN

The Biochemistry of Symbiotic Nitrogen Fixation

By Prof. Perry W. Wilson. Pp. xiv+302+34 plates. (Madison, Wis.: University of Wisconsin Press, 1940.) 3.50 dollars.

The study of the nitrogen fixation which proceeds within nodule-bearing leguminous plants provides a common meeting-ground for several branches of natural science. Bacteriologists, botanists, chemists, students of agriculture, all have found opportunities, not always lucrative, for investigation. The attention lavished on the subject by such varied workers, while it ought to result in a more all-round progress, inevitably complicates the task of anyone attempting to keep in direct touch with the multitude of original publications, dispersed as these are through scientific journals of every description. There should, therefore, be a ready welcome for a monograph such as that prepared by Prof. P. W. Wilson with the help of his colleagues in the Department of Agricultural Bacteriology of the University of Wisconsin, especially since it bears the hallmark of authority of a distinguished centre for the study of biological fixation of nitrogen.

The monograph is described as a sequel to the well-known earlier one from the same department by Fred, Baldwin and McCoy, and refers especially to those aspects of symbiotic nitrogen fixation (chiefly biochemical) that have undergone considerable development in the last decade. Topics dealt with include the biochemistry of the bacteria in pure culture, the interaction of host plant and bacteria, the chemical mechanism of the fixation process, the effect of the carbohydrate-nitrogen balance in the host on fixation, excretion of nitrogenous substances from nodules into rooting medium, physico-chemical studies of possible enzyme systems, and a discussion of practical applications. A certain number of hitherto unpublished observations, views, and conclusions are included, and several hundred references are furnished, mostly to publications of the last ten years. The work is illustrated by numerous photographs and diagrams, most of which are of a high standard and amply fulfil their purpose. It is natural that a considerable proportion of the monograph should be devoted to the statement and consideration of results obtained in the Madison department, in view of the intensive investigations carried out there. Though he writes essentially for the specialist, Prof. Wilson treats his subject in as broad a fashion as possible. Thus in the introductory chapters passages are quoted from agricultural treatises dating from the opening of the Christian era. Anyone feeling this historical approach to be unnecessary would do well to note, as Prof. Wilson does, the complaint made by some modern investigators in this field that earlier workers thought of everything and anticipated many more recent "discoveries".

Prof. Wilson makes a notable attempt to reduce to some sort of order the seemingly chaotic results of studies on certain aspects of the subject, especially those relating to the excretion of nitrogenous substances from the nodules into the rooting medium. He has reached the conclusion that considerable differences may exist in the biochemistry of the same variety of leguminous plant and its nodules when grown under different climatic conditions. This extends to variation in the identity of the intermediates in the fixation process. The occurrence of excretion is considered to be dependent on a particular metabolic event — the accumulation of aspartic acid in the nodules. In this connexion the reviewer may perhaps be allowed to suggest that more attention might be paid by investigators at other stations to those original experiments of Prof. A. I. Virtanen in which the plants were grown practically by artificial light alone, still with the occurrence of excretion. In such experiments a degree of standardization of conditions may be achieved which is almost impossible if natural light is employed, and the investigation of factors of a non-climatic type is thus facilitated.

Prof. Wilson is endowed with a keenly critical mind, and does not hesitate to expose what seems to him to be faulty technique or reasoning. The result is that it is not unknown for him to be involved in disputes with other investigators, but few will quarrel with the view he expresses here that controversy is in fact desirable and useful, provided it avoids the acrimonious. It is indeed a tribute to Prof. Wilson's energy and perspicacity, with which the reviewer was previously acquainted, that this volume should have been produced without appearing to affect the output of original papers from the Madison department. In a lighter moment, Wilson and Fred subjected the vast literature dealing with leguminous nitrogen fixation to mathematical analysis, and concluded that an annual publication of approaching one hundred articles was soon to be expected, though it is probable that this rather fearsome climax has now been postponed. In this latest monograph we have a substantial addition to the 1940 quota of literature, but one which will be of great use to a variety of investigators. G. BOND.

THE ENGINEER'S YEARBOOK

The Engineer's Year-Book of Formulæ, Rules, Tables, Data and Memoranda for 1941
A Compendium of the Modern Practice of Civil, Mechanical, Electrical, Marine, Gas, Aero, Mine and Metallurgical Engineering. Originally compiled by H. R. Kempe and W. Hanneford-Smith. 47th annual issue, revised under the direction of L. St. L. Pendred. Pp. xii+2778+lvii. (London: Morgan Brothers (Publishers), Ltd., 1941.) 35*s.* net.

ONCE again, despite all the difficulties associated with war-time publication, "Kempe" has appeared and to all external appearances differs in no respect from its earlier issues. There is more in this than mere sentiment, for the publication of "Kempe" has become an important annual occasion in the engineering world. Originally designed by H. R. Kempe, engineer-in-chief at the General Post Office, to be a work which, being carefully brought up to date year by year, should take its place as the standard book of reference in the engineering profession, it has in actual fact attained to this eminence and fulfilled the destiny planned for it.

The 1940 edition, being the first affected by the present War, was subjected to some major alterations such as the elimination of the section dealing with costs, which had been rendered useless by the new conditions. In its place, the mathematical tables were reinstated, and it is in precisely the same form as that of its immediate predecessor that the 1941 edition has been issued. Last year the demand, instead of being smaller than usual as might have been anticipated, actually proved to be enhanced by the changed conditions, thus confirming the need for such a publication and the reliance which engineers have come to place upon "Kempe". The range of information packed into its many pages is amazingly wide, and, being well documented and backed by the high reputation of the men who have contributed its various sections, can be relied upon to yield most of the established data such as may at any moment be required by a practising engineer in one or other of the branches enumerated in the bibliographical particulars given above.

Two minor omissions should be made good in due course. In the section on belt conveyors an empirical formula for the power required to drive a conveyor of this type includes a term representing the weight of the belt; but no information appears as to the weight of such belts. Further, formulæ are given for the approximate strength of wire and manila ropes, but for cotton ropes for there are no such data.

EVERYDAY CHEMISTRY

An Introduction to Chemical Science
By Prof. W. H. Hatcher. Pp. viii+423. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1940). 18*s.* net.

THIS book is based on a course of lectures which has been developed over a period of years by the author in an attempt to give to non-scientific students at McGill University a cultural appraisal of chemistry.

The book is divided into four main parts, namely, inorganic, organic, food and industrial chemistry, and contains a bibliography and comprehensive index. In the first part, an introductory account is given of the non-metals and their more important compounds, and this, quite rightly, is blended with an elementary discussion of solutions, colloids and the atom. A broad survey of both metals and non-metals is also given in three chapters which are devoted to the classification of the elements.

Part 2 provides a satisfactory introduction to organic chemistry, a special feature being the number of large and well-printed structural formulæ. The non-specialist is helped by the omission of detailed descriptions of preparations and properties, although this commendable feature is rather marred by the naming of too many complex organic compounds.

The section on the chemistry of foods, Part 3, should be of particular interest at the present time to both scientific worker and layman because the relative values of various foodstuffs are compared. The chemistry of digestion is explained, as also are some of the mysteries of the kitchen. An elementary account is given of the vitamins, and this includes an interesting table of an adult's requirements of vitamins and the weights of different foodstuffs containing these quantities. Incidentally, the figures in the table refer to the *daily* requirement of an adult, but the author has omitted to mention this fact.

The final section of the book, Part 4, gives a simple but interesting survey of industrial chemistry. The sources and methods of obtaining the raw materials are first described, and then elementary details are given of the chemical processes whereby these raw materials are made to yield metals, acids, ceramics, refined oils, etc.

This volume, which is printed in large type and strongly bound, should prove a valuable addition to any library. The intelligent layman and the sixth-form pupil on the non-science side will find much of interest in the book, while chemistry teachers will find useful material in it for the preparation of their general science courses.

A. C. C.

MEASUREMENT OF TEMPERATURE

A Manual of Heat and Temperature Measurement
Compiled by Robert L. Weber. Pp. vii+141. (Ann Arbor, Mich.: Edwards Brothers, Inc., 1939.) 2.85 dollars.

Temperature Measurement
By Robert L. Weber. Pp. x+172. (Ann Arbor, Mich.: Edwards Brothers, Inc., 1941.) 2.50 dollars.

THE interest of these volumes lies chiefly in the light which they throw on the methods adopted in a progressive American university to give a practical course to those who will afterwards use scientific instruments in their work. Each book is in two parts, the first an outline of the subject, the second giving the laboratory notes for about twenty experiments.

In the manual of heat and temperature measurement, Part 1 would strike an English student as far too scrappy to be of any value except for revision: in twelve chapters, of an average length of 6 or 7 pages each, the subject of heat is dealt with. Chapter iv, on the other hand, occupying 15 pages (including a full-page photograph of the outside of a potentiometer indicator), compensates for these defects by giving a much fuller, helpful and critical account of thermocouples and their uses than would be found in a British text-book. Subsequent chapters deal sketchily with the theory and well with the practice of radiation pyrometry and resistance thermometry. There are very good chapters indeed on recording pyrometers and on automatic control of temperature. Part 2 of either volume would offer suggestions to many teaching institutions. The whole outlook is practical, and the experiments are well chosen to illustrate principles and yet to introduce the student to instruments likely to be used in his subsequent career.

The later book, on the other hand, deals more thoroughly with its less extensive subject. The outlook is admirably practical, and there are tables of the properties of thermo-electric metals and of refractories, in addition to other data which make the book of value to the worker in heat, as well as to those in the student stage. All branches of temperature measurement—including the extremely low and the extremely high—are considered, and such matters as flame temperature are not overlooked.

The books have been photographically reproduced from typescript, presumably with the figures gummed on to the copy, and the result is pleasing. They are bound in a limp cloth which seems likely to withstand student handling, and would well repay perusal, if not by students, at any rate by those who plan their courses of instruction. Many of the figures lack any informative value, and some are too dark to show any detail, but a pair on p. 101 of the later work, showing interference fringes caused by heated streams of air, are magnificent.

In each book there is an appendix of tables, larger in the 1941 book than in its predecessor, noteworthy among them being a compact table of the E.M.F. of thermocouples every 2° from 0° to as high as 1720° C., and occupying no more than a page.

THE SUN AS A PRODUCER OF ENERGY*

BY PROF. S. CHAPMAN, F.R.S.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

RADIANT AND GRAVITATIONAL ENERGY

THE existence of ionized layers in the earth's atmosphere is due to solar radiation, but in the *phenomena* of the ionosphere an entirely different cause plays a secondary part, namely, gravitation, exerted in the form of tidal forces, more by the moon than the sun.

The same two distinct causes provide the energy that electrical engineers develop and apply in so many ways. The sun's radiation is the chief source. Though engineering based on the direct use of the sun's heat is not yet practicable on any large scale, great use is made of past sunlight, stored up in the coal measures; and hydro-electric power comes from solar radiation of our own time, which raises water from the sea to the sky; it descends as rain, and some of this rain-water flows through turbines on its way from the highlands to the sea. A secondary source of energy is gravitational, namely, the sea tides, especially where these are magnified in narrow channels.

SOLAR ENERGY: THE GRAVITATIONAL THEORY

Helmholtz thought that ultimately these two sources were the same—that the sun's radiation is derived from potential energy of gravity which the sun once possessed in much larger measure than it does to-day. In his view the sun was formerly a sphere of rare cool gas, far larger than now; its self-attraction caused it to contract, and as the outer layers 'fell' inwards or 'downwards' towards the centre, the gas within was compressed and its temperature rose. Thus the sun gradually became hot, from the centre outwards. When the heat had spread to the surface, the sun became luminous, and its transformed gravitational energy was poured out as radiation.

On the basis of this theory Lord Kelvin concluded that the sun could not have shone with its present brightness for more than about 20 million years, and that therefore the geological changes and the evolution of life on the earth must have been limited to this period. Impressed by his authority, some geologists accepted his estimate; others, more independent in mind and more confident in their own data, rejected it; we know now that they were right.

THE SUBATOMIC SOURCE OF SOLAR ENERGY

These two great men, Helmholtz and Kelvin, were dealing with a real and important feature of the sun's power supply, but perforce they missed the main point, which was beyond the science of their time. The present output of solar energy is not of gravitational origin; it is produced in the central region of the sun, from subatomic energy, by a special type of combustion or chemical reaction.

The fuel is hydrogen, and of this the sun has large reserves, comprising about a third of its mass. The product of combustion is helium.

TERRESTRIAL AND SOLAR COMBUSTION

The solar combustion has interesting analogies with the burning of coal in a furnace, but in other ways it is remarkably different. In a coal furnace one carbon atom combines in successive stages with two oxygen atoms to form a complex molecule, carbon dioxide. The reactions are essentially of the form:

$$2C + O_2 = 2CO,$$
$$2CO + O_2 = 2CO_2;$$

and in the process energy is emitted in the form of heat. The burning begins only if the coal is first heated to a suitable temperature; its combustion then maintains this temperature.

The combustion in the solar furnace likewise produces one complex particle, a helium atomic nucleus, out of four simpler particles, in this case four hydrogen atomic nuclei; and in the process energy is emitted, mainly in the form of radiation of very short wave-length, namely, γ-radiation. The process begins only when the solar gas is raised to a very high temperature and density or pressure.

Herein lies the important part played by the gravitational contraction considered by Helmholtz and Kelvin; this produces the necessary temperature and pressure, twenty million degrees centigrade and ten thousand million atmospheres, near the centre of the sun. Thereafter the 'burning' of the hydrogen nuclei can maintain the temperature and prevent further contraction for thousands of millions of years, during which the sun radiates with at least its present brightness.

One may say that the solar furnace, like some types of internal combustion engine, was ignited by compression. Helmholtz mistook the brightness and the radiation leakage during the initial ignition process (occupying only a few million years) for the main and much more productive process of energy generation from subatomic sources.

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* From the earlier part of the thirty-second Kelvin Lecture to the Institution of Electrical Engineers, entitled "The Sun and the Ionosphere", delivered on May 8.

ORDINARY MATTER AND NUCLEAR CRUSHED MATTER

In a coal furnace the atoms and molecules that take part in the combustion are electrically neutral systems. They consist of small positively charged nuclei, containing almost all the mass, with an outer structure of light negative electrons.

In the central solar furnace the outer structure of all atoms is broken up ; the gas therefore consists of free nuclei and free electrons. This 'crushed matter' is much more compressible than ordinary matter, and at the centre of the sun its density is about eighty-five times that of water.

Thus the combustible part of the central gas consists of hydrogen atomic *nuclei* (also called protons). These combine to form helium atomic nuclei (also called α-particles). The negative electrons present play no direct part in the combination.

THE MAIN REACTION IN THE SOLAR FURNACE

In a coal furnace oxygen is as essential to the combustion as the coal itself, and two atoms of oxygen (or one molecule) lose their separate existence for each carbon atom 'burnt'. The oxygen has an equal right with the carbon to be considered as fuel, though because it costs nothing we may ignore this.

In the solar furnace the fuel is hydrogen nuclei or protons. But these do not combine together directly ; they are built up into helium nuclei in the course of a six-stage reaction involving a catalyst. The catalyst is a particle that undergoes a cycle of successive transformations but is left finally unchanged. At the outset of the helium-building reaction, the catalyst is an ordinary carbon nucleus ${}_6\mathrm{C}^{12}$[†] ; it undergoes four successive combinations, with one proton at a time ; two of its intermediate forms are unstable, and undergo a spontaneous radioactive transformation, with the emission of a positive electron. The outcome of the fourth combination is a helium nucleus and an ordinary carbon nucleus as at first. The helium nucleus has been synthesized from the four protons, and the carbon nucleus is ready to start another such reaction cycle.

The equations of the six nuclear-chemical reactions are as follows, where I have added a + sign to the suffix as a reminder to the reader that the suffix indicates the number of elementary positive charges possessed by the particle ; also e_+ denotes a positive electron carrying one positive charge, and of very small mass. In each equation the sum of the suffixes on the two sides are the same, and likewise the sum of the affixes ; these equalities correspond to the conservation of charge and of mass.

2½ million years

$${}_{1+}\mathrm{H}^1 + {}_{6+}\mathrm{C}^{12} = {}_{7+}\mathrm{N}_{13} + \text{gamma ray}$$

10 minutes

$${}_{7+}\mathrm{N}^{13} = {}_{6+}\mathrm{C}^{13} + e_+$$

50 thousand years

$${}_{1+}\mathrm{H}^1 + {}_{6+}\mathrm{C}^{13} = {}_{7+}\mathrm{N}^{14} + \text{gamma ray}$$

4 million years

$${}_{1+}\mathrm{H}^1 + {}_{7+}\mathrm{N}^{14} = {}_{8+}\mathrm{O}^{15} + \text{gamma ray}$$

2 minutes

$${}_{8+}\mathrm{O}^{15} = {}_{7+}\mathrm{N}^{15} + e_+$$

20 years

$${}_{1+}\mathrm{H}^1 + {}_{7+}\mathrm{N}^{15} = {}_{6+}\mathrm{C}^{12} + {}_{2+}\mathrm{He}^4$$

Preceding the line for each reaction a time is stated ; this is an estimate of the time that elapses, under the conditions existing in the solar furnace, before the reaction occurs ; Bethe, to whom this theory and these estimates are due, states that the times may be wrong by a factor 3 either way, except the shortest two, which are based on observation in the laboratory. The three long intervals illustrate the rarity of combinations at which two nuclei combine to form a single particle with the emission of the excess energy as radiation ; this occurs only when the collision satisfies certain highly restrictive conditions. Hence the last combination, in which two particles, without radiation, result from the collision of two other particles, is far more probable than the possible alternative

$${}_{1+}\mathrm{H}^1 + {}_{7+}\mathrm{N}^{15} = {}_{8+}\mathrm{O}^{16} + \text{gamma ray.}$$

The equations show that it takes a few million years for any one carbon nucleus, fertilized by four successive protons, to bring to birth one α-particle. If the birth-rate is high at the centre of the sun, it is because the number of carbon atoms and protons there is immensely great.

[†] The chemical nature of an atomic nucleus is determined by the number of (positive) elementary charges that it carries ; for hydrogen, helium, carbon, nitrogen and oxygen nuclei these numbers (called the *atomic numbers*) are respectively 1, 2, 6, 7, 8. The nucleus is conveniently denoted by the appropriate chemical atomic symbol together with a suffix indicating the atomic number or number of positive charges (though either the number or the atomic symbol would suffice, as the atomic number uniquely determines the symbol). Thus the nuclei of hydrogen (a proton), helium (an α-particle), carbon, nitrogen and oxygen are denoted by ${}_1\mathrm{H}$, ${}_2\mathrm{He}$, ${}_6\mathrm{C}$, ${}_7\mathrm{N}$, ${}_8\mathrm{O}$. The mass of the nucleus is not uniquely determined by the charge or atomic number; nuclei of different masses but the same charge are called isotopes. The atomic mass may conveniently be indicated by an upper integer affix, equal (very nearly) to the chemical *atomic weight*. Thus a proton and an ordinary α-particle are denoted by ${}_1\mathrm{H}^1$, ${}_2\mathrm{He}^4$, and the isotopes of carbon, nitrogen and oxygen that occur in the solar central reaction are ${}_6\mathrm{C}^{12}$, ${}_6\mathrm{C}^{13}$,${}_7\mathrm{N}^{13}$, ${}_7\mathrm{N}^{14}$, ${}_7\mathrm{N}^{15}$, ${}_8\mathrm{O}^{16}$; of these ${}_7\mathrm{N}^{13}$ and ${}_8\mathrm{O}^{15}$ are unstable.

THE ENERGY PRODUCTION

The catalytic combination of hydrogen nuclei is enormously productive of energy. Whereas the ordinary combustion of 1 lb. of coal gives heat energy equivalent to $4\frac{1}{4}$ electrical units, the 'burning' of 1 lb. of hydrogen nuclei produces radiant energy equivalent to nearly 100 million electrical units.

Energy has mass, though only 1 gram to 25 million electrical units; hence the radiant energy produced from 1 lb. of hydrogen nuclei has a mass of 4 gm.; the mass of the resulting helium nuclei falls short of 1 lb. by this amount—a perceptible diminution.

Helios, the sun, is a power producer on the grand scale. Its heating and lighting output is nearly half a billion billion kilowatts (more exactly, $3{\cdot}8 \times 10^{23}$ kw.), and I use billion in its English sense, to signify a million million. The corresponding loss of mass is at the rate of 4 million tons per second.

THE OUTWARD STREAM OF RADIANT ENERGY

This energy is generated in the central solar furnace mainly as gamma radiation. This struggles upwards through the immense surrounding mass of overlying gas, ever cooler and less dense the farther from the centre. The radiation is continually degraded in frequency or increased in wave-length, and finally it leaves the sun with a spectral distribution corresponding roughly to a temperature of 6,000° C. It consists of electromagnetic waves the average frequency of which is still very high, nearly a billion kilocycles per second. As it reaches the earth and other distant consumers, it is highly directional.

SOLAR SURFACE PHENOMENA

In the upper layers of the sun the stream of outward flowing radiation energizes many surface phenomena on a grand scale. Of these the most evident are the sunspots and prominences. Much of the solar gas that we see raised above the surface in the form of prominences falls back again on to the sun, but some of it is expelled never to return. Thus the sun sends forth matter, as well as electromagnetic radiation, into the space around it. The matter, in the form of clouds or streams of rare gas, is a partner with the solar wave radiation in ionizing the earth's outer atmosphere.

ENERGY SUPPLY TO THE EARTH

Of the sun's majestic outpouring of radiant and material (kinetic) energy, all but a tiny fraction is lost in the depths of interstellar space. The father Helios scatters his riches abroad with grand prodigality, and his children the planets intercept only the merest scrap of their patrimony. Our mother earth receives less than a thousand millionth of the parental output (more exactly, the fraction is $4{\cdot}5 \times 10^{-10}$). Yet her income of over 170 billion kilowatts is not small.

All this income she spends, and perhaps a little more, drawn from her own reserves. Very little of her income can she store up for the future. From one point of view, the history of the earth since she became a separate planet is largely the story of the spending of her solar income.

INTERACTION OF VITAMINS A AND E

By A. W. Davies and Dr. T. Moore

Dunn Nutritional Laboratory, Cambridge

ONE of the most noteworthy properties of vitamin A is the extent to which it can accumulate in the liver. When the dietary intake is liberal, sufficient vitamin may be stored to meet ordinary requirements for a theoretical period of about a hundred years[1]. Some years ago we began experiments to find whether during a subsequent deficiency these large reserves would in practice be preserved and used up economically at a rate corresponding with physiological requirements, or whether they would be dissipated at an unduly rapid rate. In our first experiment a rapid dispersal of the vitamin A reserves was observed[2]. We emphasized, however, that this result was exceptional, since in earlier work large reserves had been found in the livers of rats after prolonged restriction to deficient diets[3].

For several years we tried to repeat, and explain, our observations on the rapid loss of vitamin A, but with unsatisfactory results. The influence of the exact nature of the basal diet was specially considered, and many minor modifications were made without affecting the rate of disappearance of the vitamin. Eventually a clue was obtained from an unexpected direction when it was found that the vitamin A reserves of rats which had been kept on a diet deficient in vitamin E were much lower than those of animals receiving equal amounts of vitamin A together with supplements of vitamin E[4].

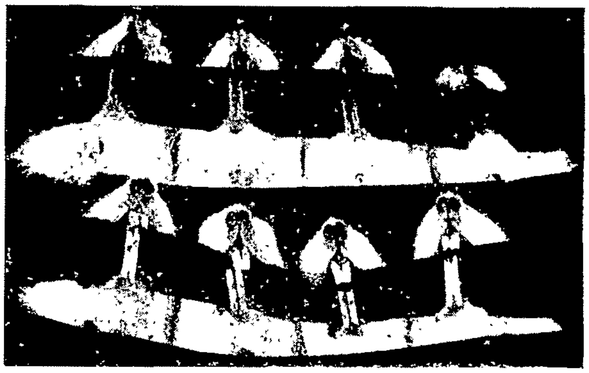
Further unpublished experiments on this point have shown that the effect in vitamin E deficiency does not lie entirely in the inability of the liver to absorb vitamin A, but also in a decreased power of retention after absorption. In the experiments to be described we have found that, under suitable conditions, deficiency of vitamin E may lead to acute secondary deficiency of vitamin A. The exhaustion of the reserves in the liver has been established directly by chemical tests. Further indirect evidence of secondary deficiency of vitamin A has been found in the appearance in the rats deficient in vitamin E of a dental abnormality hitherto ascribed to primary deficiency of vitamin A.

During a preparatory period of several weeks, young female albino rats were given an adequate mixed diet, supplemented by large doses of halibut liver oil. At intervals some of the animals were killed, and the reserves of vitamin A in their livers were estimated by the antimony trichloride method. When large reserves had been accumulated the animals were divided into two groups. Both these groups now received a basal diet deficient in both vitamins A and E (casein, Glaxo extracted 20 per cent, sugar 70 per cent, lard 5 per cent, salt mixture 5 per cent plus dried yeast 10 per cent, Radiostol, for vitamin D, 1 drop per rat per week). One group was given doses of vitamin E, in the form of 1 mgm. weekly of synthetic *dl*-α-tocopherol acetate. The other group had no vitamin E. Animals from each group were killed at intervals, and the vitamin A reserves estimated. The results obtained are shown in the accompanying table.

Days on diet deficient in vit. A and E	Vitamin A Reserves (I.U.)		Notes
	+ vitamin E	− vitamin E	
0	15,000		Rats killed after prolonged dosing with halibut liver oil before the remainder were restricted to a diet deficient in vitamins A and E
	15,000		
	15,000		
	22,500		
	22,500		
	30,000		
	mean 20,000		
28	15,000	15,000	Uteri of − E group still normal in colour
	18,000	15,000	
	30,000	18,000	
	37,500	18,000	
	mean 25,000	mean 16,500	
91	9,000	3,700	Uteri of − E group light brown
	12,000	4,500	
	15,000	4,500	
	15,000	6,000	
	mean 13,000	mean 4,700	
222	3,750	5	Uteri of − E group dark brown, teeth white
	6,000	6	
	6,000	9	
	7,500	15	
	mean 5,800	mean 9	

N.B. Growth was slightly more rapid in the + E than in the − E group. The mean initial weight of the + E rats which survived 222 days was 132 gm., the final weight 212 gm. The mean initial weight of the corresponding − E rats was 139 gm., the final weight 171 gm. During the last 100 days of the experiment the − E rats declined slightly in weight, and the fat reserves at autopsy were sparse.

In both groups the rate of loss of vitamin A exceeded that calculated from the presumed physiological requirement. An allowance of 10 I.U. per day should be sufficient for rapid growth in adolescent rats. On this basis not more than about 2,000 I.U. should have been used up in the animals kept on the deficient diet for 222 days, as compared with a minimum actual loss of 14,000 I.U. There was, however, a consistent difference between the two groups. At all stages of the experiment the vitamin A reserves of the rats given tocopherol were greater than those of rats which had no vitamin E. After restriction to the deficient diet for 222 days the reserves of the animals having tocopherol were still high, the mean total reserve being 5,800 I.U. The reserves of the untreated group were too low for accurate measurement, the mean being 9 I.U. The faint traces of colour given by the liver oils of this group, moreover, were not of the usual bright blue shade but a dull purple, similar to that given by preparations of vitamin A after partial destruction by oxidation. It is therefore doubtful what proportion of the colour can be attributed to unchanged vitamin A.



Top row, + vitamin E, normal teeth; bottom row, − vitamin E, white teeth

At autopsy evidence of vitamin E deficiency in the rats not given tocopherol was obtained by inspection of the uteri. In the groups killed after 91 and 222 days of deficiency the brown discoloration described by Martin and Moore[5], which is characteristic of deficiency of vitamin E in the rat, was always observed. The uteri of animals protected by tocopherol were all normal in colour.

Another striking difference between the two groups was seen in the teeth, which were of the normal brown colour in the group given tocopherol, but almost white in the untreated group (see accompanying illustration). Whitening of the teeth in vitamin A deficiency has been studied by several investigators[6,7,8,9]. According to H. Mellanby[10] the changes can be explained as arising primarily from a metaplasia of the epithelial cells of the enamel organs, which leads to secondary changes in the odontoblasts and dentine. If this conclusion is accepted, and the relation between whitening of the teeth and deficiency of vitamin A is regarded as specific, it is clear that the appearance of this abnormality in the untreated group affords additional evidence of the occurrence of secondary vitamin A deficiency. In our experience however, partial whitening of the teeth may occur in rats which are deficient in vitamin E, but which still have considerable reserves of vitamin A in their livers. We have also occasionally observed brown teeth in rats which have died from deficiency of vitamin A. It may possibly be better, therefore, to regard this lesion as a common effect of deficiency of either vitamin.

Sections of the tracheæ of the rats not given tocopherol were examined, but only in one instance was the normality of the epithelium open to question.

In the above experiment we have achieved the apparent paradox of preventing deficiency of one vitamin by the administration of another vitamin. In the absence of full data on the effect of deficiency of other vitamins we cannot decide how far the role of preserving the vitamin A reserve is peculiar to vitamin E. We know, however, that the vitamin A reserves are not much reduced in deficiency of the vitamin B complex[3] or in prolonged deficiency of protein so severe as to cause emaciation and complete cessation of growth in young rats[4]. Some support for the possibility of a specific interaction between vitamins A and E may be derived from a consideration of their chemical properties. The tocopherols are higher substituted members of the class of hydroxy-aromatic substances of which hydroquinone is a lower and less hydroxylated member. This substance is often used for stabilizing solutions of vitamin A in fats. The tocopherols may possibly have a similar action under physiological conditions.

The present results explain the rapid loss of vitamin A reserves observed in our early experiment[2] if we assume, as seems highly probable, that the basal diet used on that occasion was unintentionally deficient in vitamin E. Our knowledge of the role of vitamin E in human nutrition is too scanty to allow speculation as to whether the present findings have any clinical significance. From estimations of the vitamin A reserves of humans at autopsy, however, we know that secondary subnormality of vitamin A is common and sometimes severe. Thus the medium reserves for forty cases of chronic nephritis was found to be 25 I.U. per gm. of liver as compared with 220 I.U. per gm. in accidental death. Any factor, such as vitamin E deficiency, which causes secondary vitamin A deficiency in experimental animals must be worth consideration in the investigation of human diseases in which the reserves of vitamin A are known to be reduced.

SUMMARY

(1) In rats restricted to a diet deficient in both vitamins A and E the reserves of vitamin A were used up much more rapidly than in control animals given *dl*-α-tocopherol.

(2) Prolonged deficiency of vitamin E led to secondary deficiency of vitamin A, as indicated by the disappearance of this vitamin from the liver. The deficient rats also developed the whitening of the teeth which is generally held to be an effect of deficiency of vitamin A, but which may perhaps be considered a common result of deficiency of either of these vitamins.

Our thanks are due to Dr. L. J. Harris for his valuable criticism, and to Roche Products Ltd., for gifts of *dl*-α-tocopherol.

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FEEDING DRIED NETTLES TO LIVESTOCK

By W. KING WILSON,
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THE quantity of stinging nettles grown unwillingly throughout Great Britain must amount to a very considerable weight of material each year. What is its food value ? According to average figures for the chemical composition of dried nettle leaves, they compare very favourably indeed with hay of good quality and would appear to be as good as clover, lucerne or sainfoin in their content of protein, while the fibre is generally shown to be lower in nettles than in hay, even when the latter is of a very good grade.

Furthermore, digestion trials have shown that nettle leaves are highly digestible and in this respect also rank with the best species and grades of hay. Although fibrous in character, they are nevertheless well utilized by animals which normally have only low powers of digesting fibre, such as the pig, fowl and rabbit. Nettles mixed with straw chop have been used effectively in feeding cows and horses, but the amounts available are usually better suited for use with small livestock, and it is with these that experiments have usually been made. Such experiments were carried out in Germany[1] and gave results for digestibility which were somewhat better with nettles than with lucerne hay, and conspicuously better than with meadow hay. The figures for the total organic matter digestion coefficients were 63, 61 and 47 per cent respectively, while the comparison was even more favourable for the separate items of protein and fibre.

As these digestion trials were carried out with rabbits, even more favourable results might be expected with ruminants[2], since they are specially adapted for digesting fibrous foods. Judged by these results, and assuming that livestock will eat nettles freely, it would seem desirable that more use should be made of this common weed as fodder—and indeed it might even be better worth growing for hay than inferior grass. There seemed at least to be a sufficient warrant for the small-scale tests described below, which were carried out in the Rabbit Department of the National Institute of Poultry Husbandry.

PALATABILITY OF NETTLES (DRIED)

A few tests of the palatability of nettles may first be noted: The rabbits were kept in sheds with grass runs adjoining, where the grass was closely grazed until there was none left in the summer time and additional green food had to be fed. Even when the runs were bare of grass, the animals did *not* eat the stinging nettles when the nettles were growing even when they were very short, young and leafy. This result was obtained each year, and was checked in the past season with thirty more animals; these animals were kept short of green food, but only slight nibbling could be induced on a few of the growing nettles. The nettles were then mown and left on the ground, where they remained, and normal feeding was resumed. During the following month all the dried-up nettles were eaten, including the stems. (It will be noted that this is exactly the reverse process from inducing stock to eat the common thistle, for thistles should be young and tender if they are to be eaten by stock.) More nettles were cut and made into hay before reaching the flowering stage; less turning was necessary than is usual with hay, owing to their stalky nature when cut. Later, the dried nettles were fed to ten adult rabbits in hutches, and although at first two refrained from eating them for two and for three days respectively, they all ate them readily after the first few days. Feeding continued as with normal hay and they were evidently a palatable food.

A further supply of stinging nettles was cut, but as the weather then seemed unsettled and rain likely, these nettles were carted indoors about the third day. These were fed to ten young hutched rabbits at the half-grown stage, but this lot practically refused them after nibbling the first few pieces. The rest of the ration was then curtailed, but none of these young animals would clear up the nettles. The only noteworthy difference in this nettle hay was that it was cut later and carted before it was as well made as could be wished for; it was, however, a good green colour. When this was handled, it gave a decidedly tingly or irritating sensation; that is, it retained some of its sting, which had practically disappeared in the better-made earlier-cut nettle hay which had been kept ten days or more.

EXPERIMENTAL

With the guidance of the foregoing preliminary observations, an experiment was started with nettles cut and dried for 3–4 weeks: twenty young rabbits, approximately two months old, were divided into two similar groups and fed for eight weeks on a mixed diet of greenfood, roots, mash and hay. The first group, acting as the control, received the usual grass hay available from poultry runs. This was mainly composed of the coarser grasses including cocksfoot, and generally of a low grade. The other group was fed on a similar ration except that grass hay was replaced by an equal weight of dried stinging-nettles—after they had lost their sting—cut before the flowering stage. Care was taken to use nettles which were free from grass or weeds. The quantities of food were kept level in both groups, although it was soon noticed that the nettle group consumed their hay quicker than the lot on the coarse grass hay. As the stock grew older, the amount of food was increased but only to the level at which the grass hay group would clean up their ration. The amount of foodstuffs used daily for these small youngsters started off at a daily average per head of: 0·71 oz. of hay, 2·64 oz. kale and swedes and 1·48 oz. of dry mash. Water was drunk at the rate of 0·10 pint per head daily. The quantities of food were increased in the following month to 1·03 oz., 3·09 oz. and 2·01 oz.; this was the rate at which the controls cleared up their daily allowance but appeared to be less than the nettle group would have taken if allowed an unrestricted diet. In the following weeks it became even more noticeable that the nettle group finished its food more quickly than the grass hay group. There was a tendency for the latter to be troubled with intestinal obstruction when very rank hay was used.

The animals were weighed at regular intervals, and at one month after this feeding started there was a perceptible difference in the condition of the two groups, which became more evident as the length of the feeding period increased. In the early weeks, body condition and coat were rather better on nettles and, as the system continued, the live weights illustrated the definite advantage of feeding nettle hay compared with coarse grass hay, as the nettle-fed stock weighed on the average 8·7 per cent heavier than the controls. If expressed as a percentage gain over the controls, it amounted to 17·0 per cent. They were very hard and firm when handled, and tighter in the skin than controls.

Data for the two groups are set out below:

The quicker growth and heavier weights of the nettle-hay group showed a further advantage in the ratio of food consumption per pound gain i live weight. There was a saving of 15·56 per ce in the amount of concentrates used for each pou of live-weight gain when fed with nettle hay. Th

BODY WEIGHT AND CONDITION (OZ.)

Group:	Grass Hay	Nettle Hay
Initial live weight, average	27·10	27·10
Final live weight, average	55·30	60·10
Average live weight gain	28·20	33·00
Difference in gain, as percentage of gain made by control	—	17·02
General body condition, at final weighing	Quite good	Excellent
General coat condition, at final weighing	Moulty and rough	Moulty, but gloss and silky texture

glossy coat produced by the nettle feeding is special interest, since the same effect has bee claimed for nettles when fed to horses.

Acknowledgement is made of the advice a assistance received from Dr. Charles Crowther.

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OBITUARIES

The Right Hon. Lord Cadman, G.C.M.G., F.R.S.

THE very complete biographies of the late Lord Cadman, who died on May 31 at the age of sixty-three, that have appeared in the Press render it unnecessary to deal with his multitudinous activities here.

It is rather the intention of the writer to throw into relief his achievements as a man of science, and it is more than likely that it is just this aspect of his life that Lord Cadman would have wished emphasized.

After more than twenty-five years of close association with him, it is apparent that the scientific approach to industrial problems had assumed an overwhelming importance. In all the wide gamut of the petroleum industry from the initial geophysical exploration, the geological demarcation of oil-bearing formations, the technology of drilling, the corrosion of pipe-lines and plant and ships to the chemistry of refining processes, his fluid and prehensile mind was fully occupied and extended. There was probably no one man of our epoch with the same encyclopædic knowledge and, what is more important, the same wide and active sympathy with those who were associated with him as his scientific colleagues.

In his younger days Cadman was primarily a 'coal' man. At the age of twenty-six he was appointed H.M. Inspector of Mines for East Scotland and very shortly after was seconded to Trinidad as Government mining engineer. It was in this position that he encountered the multitudinous problems of the petroleum industry. Returning to England in 1907, he became professor of mining in the University of Birmingham, a post he held for thirteen years, during which time he founded the first school of petroleum technology to be established in the Empire and was professor emeritus at t time of his death. It was in Birmingham that h close collaboration with his old friend, the late Pr J. S. Haldane, began, and a fruitful series of investigations into various mine hazards was accomplishe In the War of 1914–18 he was intimately concerne in the problems of trench warfare and of gas protection. Ultimately he was made director of th Petroleum Executive and chairman of the Int Allied Petroleum Council. He co-ordinated all supplies both for the United Kingdom and the Alli During these busy years and for long afterwar he retained his interest in the scientific and techni aspects of industry, served on innumerable c missions and committees and occupied the presiden chairs of the Institute of Petroleum, the Institute Fuel and the Institute of Mining Engineers.

He received the medals awarded by the latter tw bodies. He served on the Advisory Council of t Department of Scientific and Industrial Research the Privy Council, the Safety in Mines Resear Board, the Coal Advisory Council and the Pri Minister's Economic Advisory Council. He was member of the Fuel Research Board from 1923 un his death, except for a short break of four year During the time he was a member of the Board, was intensely interested in the work and took prominent part in the discussions in the Boa Although he was so intimately associated with c his association with the coal industry had left hi with real sympathy with the subject, and he nev hesitated to use his influence to further the scienti application of coal. He continually advocated t complete gasification of coal so that cheap gas co be made accessible in large volumes in Great Britain. He also took a great interest in the production of ptor spirit from coal by the hydrogenation process. he coping stone of his scientific career was placed ly last year by his election to the fellowship of the yal Society.

As one of his oldest colleagues, the writer wishes to ess Cadman's perpetual insistence that no industry n flourish that is not soundly based on truly ientific foundations. In the Anglo-Iranian Oil ompany he fostered research. He was responsible r the creation of the largest petroleum research ation in the Empire and one that will bear every mparison with corresponding organizations abroad. e was deeply sensible of the need of the latest and est scientific advice. He supplemented the efforts f his own staff with those of highly skilled and minent advisers. He continually visited the lab- atories and took the keenest interest in the welfare nd well-being of his staff. In return he was rewarded y a constant stream of invention, discovery and development.

A. E. DUNSTAN.

Dr. R. Campbell Thompson, F.B.A.

REGINALD CAMPBELL THOMPSON died of heart lure after coming off duty with the Home Guard the night of May 23. He was the last repre- ntative in England of a phase of Assyriology hich converted that study from a discovery into science. When he was a boy at St. Paul's, he was attracted, by the results attained by the early Assyriologists during the heroic days which had pened with the measured judgment on translations submitted by four different scholars in 1842, by a committee which did not profess to understand the text translated. By the time he reached aius College, Cambridge, the *epigoni* had been busy or some fifteen years producing grammars, diction- ries, catalogues of tablets; the exciting work of ecipherment and interpretation on the lines of Sir enry Rawlinson, George Smith, Oppert and Sayce as becoming a science and was a subject favoured German, but not by English, or even French, niversities. When he entered the British Museum n 1899, already well equipped for Assyriological udies, the ground had been prepared for the classi- cation of Babylonian and Assyrian texts, for ethodical publication of texts by classes and for he codification of results.

For forty years Thompson contributed, sometimes th the brilliant success of the pioneers he most lmired, but also by steady and laborious work, to he new conditions of his chosen subject. Between 900 and 1908 there appeared in the official publica- ion of the British Museum copies from his pen of abylonian syllabaries, magical incantations against vil spirits, Babylonian letters of the late period, ach class of document arranged after examination f great numbers of tablets and fragments, all the opies in beautiful script, the standard of accuracy emarkable. In addition to this great output, he lited, in private publications, texts dealing with trology, magic and social life. In each of these branches, more particularly in astrology, his work was of outstanding importance, for he was able to discard much worthless nonsense that had been written on the subject and produce an interpretation of the astronomical phenomena involved, on which subsequent studies have been firmly based. He then turned to the study of comparative religion; his volume on "Semitic Magic", though affected by prejudices and questionable preconceptions, contains information not to be found elsewhere, which ought not to be neglected by younger scholars as it has been.

After the break caused by travel when he left the British Museum, and by service in Intelligence during the War of 1914–18, Campbell Thompson's principal scientific work was concentrated on the publication and interpretation of those Assyrian texts which contained prescriptions for the sick, in the form of omens, or recipes for making glazes of glass. After publishing the original texts of most of the documents himself, he undertook the strenuous labour of classifying and interpreting the names of plants and stones, using for this purpose the scattered references in the wide range of cuneiform literature, and applying comparative material that required minute study. In two books, the "Assyrian Herbal" and the "Dictionary of Assyrian Chemistry and Geology", he provided two model works for the history of science, which have indeed been heavily drawn upon by general writers on that subject. The collection of material is beyond praise, the interpretations suggested always reasonable, most often correct, sometimes brilliant in their insight. These two works constitute Thompson's great contribution to humane learning, and it is the more to be regretted that owing to circumstances he was not able to see a printed edition of his "Assyrian Herbal" to press; the fitting tribute to him would be that such an edition should yet appear.

He was a man of many-sided interests, of boundless energy and enthusiasm. His chapters in the "Cambridge Ancient History", vols. I–III, give the liveliest, most human picture of the ancient Babylonian civilization yet written. His translation of the Gilgamesh Epic, following an excellent edition of the text which involved a new examination of the British Museum collections, betrays the same zest in the human quality of the story. As a traveller, he loved the manners and methods of the past, and aimed at describing his experience in the words of the past, as in "Pilgrim's Scrip" (1915). Excavations at Carchemish, at Wadi Sarga in Egypt, at Nineveh, were an adventure, conducted in that spirit to shock the over-serious or dull-witted. An undeciphered script, the Hittite hieroglyphs, he attacked with an optimism justified in that he was able to produce results still accepted in part. Prize poems and anonymous novels were part of his activities, and so were yachting and games.

Thompson was a fellow of Merton, Shillito reader in the University of Oxford, and fellow of the British Academy. No one who met him could fail to recognize his sterling qualities, honesty, energy, disinterested devotion to his subject.

SIDNEY SMITH.

NEWS AND VIEWS

The British Council Science Committee

THE British Council was formed in 1934. Under its charter, its object is defined as the promotion of a wider knowledge of Great Britain and Northern Ireland, and the English language abroad, and the development of closer cultural relations between the United Kingdom and other countries. The Council has already established many institutes abroad, and has active departments concerned with fine arts, music, drama, education, films, foreign visitors and students, books and other subjects. It has now formed a Science Committee under the chairmanship of Sir William Bragg. The other members of the Committee are Prof. P. M. S. Blackett, Prof. J. D. Cockcroft, Sir Robert Robinson, Dr. C. F. A. Pantin, Sir Edward Mellanby, Surgeon Rear-Admiral Gordon Gordon-Taylor, Sir William Larke, Sir Edward Appleton, Dr. A. P. M. Fleming, Mr. C. D. Le Maistre and Prof. R. V. Southwell.

Mr. J. G. Crowther has been appointed secretary of this Committee. Mr. Crowther is well known as the scientific correspondent of the *Manchester Guardian*, and has for many years been associated with the publication of scientific books. He is the author of fourteen general books on science, the most recent being "The Social Relations of Science". His book on "British Scientists of the Nineteenth Century" is also well known. Mr. Crowther has visited and written about many scientific institutions in Europe and America, and in 1937 he was invited by President Conant to deliver a course of lectures at Harvard University on the history of American science.

Bedford College, London: Chair of Zoology

PROF. H. MUNRO FOX, who succeeds the late Prof. C. L. Boulenger as head of the zoological faculty at Bedford College, London, has had a varied career. He was educated at Brighton College and Caius College, Cambridge, proceeding to the Imperial College of Science and Technology, London, as lecturer in 1913. In 1914, he enlisted in the London Mounted Brigade, in which he served until 1919, for the most part in Egypt and Palestine. In 1919 he became lecturer in biology at the School of Medicine, Cairo, leaving in 1923 to become demonstrator in zoology at Cambridge. He was already a fellow of his College and in the following year he was elected to the Balfour studentship. He then proceeded to the Suez Canal, where he investigated the fauna and conditions in relation to migrations between the Mediterranean and Red Seas, a survey which it is hoped may be repeated in 1950. The lunar periodicity in the breeding of marine animals was his discovery. In 1926 he started the *Biological Reviews* of the Cambridge Philosophical Society, of which he is still editor.

Prof. Fox's chief interest throughout his career has lain in the comparative physiology of respiration, the pigments concerned, the effects of environmental conditions, the circulatory system and respiration, especially in the marine worms. Later he investigated the properties of chlorocrurin, which has a low oxygen affinity, and its physiological relationships to the queer animals in which it is found. In particular, he was concerned with the serpulids and sabellids, in which he discovered an in-and-out circulation comparable to that which Galen supposed to exist in the human body.

Royal Anthropological Institute Awards

THE Rivers Memorial Medal for 1941 has been awarded to Dr. Diamond Jenness, ethnologist in the National Museum of Canada, for his work among the Eskimos of Arctic America. Dr. Jenness is a graduate of the Universities of New Zealand (1908) and Oxford (1911), and in 1935 was made an honorary Litt.D. of the University of New Zealand. Before being appointed in 1913 to his present post in the National Museum of Canada, he carried out field work in Papua; his principal work, however, has been among the Eskimos and Indians of North America. He took part in the Canadian Arctic Expedition of 1913–18, when he visited the Copper Eskimos; since then he has studied the Sarcee Indians of Alberta, the Carrier, Sekani and Coast Salish tribes of northern British Columbia, the Ojibwa Indians of Ontario, and has made expeditions to the Bering Straits and to Newfoundland.

The Wellcome Medal for 1940 has been awarded to Dr. Audrey I. Richards for her essay on "Bemba Marriage and Present Economic Conditions". After studying at London and Cambridge, Miss Richards was appointed lecturer in social anthropology at Bedford College for Women, and later she went to the London School of Economics. During 1934–38 and until recently she held a similar post in the University of the Witwatersrand. Dr. Richards has been especially interested in social anthropology of the functional type, particularly in psychological problems and in general problems of nutrition. In pursuit of her studies, she has made numerous expeditions to tribes in Northern Rhodesia.

Mr. Roosevelt and Oxford

Two striking parallel ceremonies took place at Harvard on June 19. Lord Halifax, British Ambassador to the United States, was given the honorary degree of doctor of law of Harvard University, and in his capacity of chancellor of the University of Oxford, he presided at a special Convocation, in which he conferred the degree of D.C.L. on President Roosevelt. Mr. Roosevelt was advised, on account of his temporary indisposition, not to make the journey from Washington to Harvard, but his friend and military *aide*, General Edwin Watson, represented him and delivered a stirring message of acknowledgment. In the Latin diploma granting the degree prepared for the occasion, reference was made to the heartening words with which Mr. Roosevelt has encouraged the defenders of liberty and to the material aid which he has given, and in ever-increasing measure is giving, to secure the defeat of lawlessness and aggression among nations, and to the stand he is making for liberty, humanity and law. Mr. Roosevelt's message mentioned the historic precedent of this special Convocation, expressing his pleasure that it "does so in the great cause of preserving the free learning and civil liberties which have grown stone upon stone in our lands". He concluded with the epigrammatic words: "We and all others who believe as we do would rather die on our feet than live on our knees."

A Dynamic Civilization

IN his presidential address "Industrial Progress, Whither and Why", before the Birmingham Metallurgical Society on March 8, Mr. C. H. H. Franklin pointed out that we are living in an epoch of dynamic change, and that whether we evolve into the finest civilization humanity has known or relapse into barbarism comparable with the Dark Ages of Europe after the fall of Roman civilization, is the principal issue. He urged that the future of industry, as of nations and of men, is being decided on the fundamental issues of free mutual co-operation, versus exploitation and compulsion. The organization of an animal or human structure provides valuable clues to the organization of our communal life, and he stressed the necessity of developing a team spirit in our industries and the concept of service of human and social needs if we are to extirpate the cancerous growth at present spreading in Europe and Asia and threatening all humanity. We need also to develop the technique of generating appropriate financial currents for human utility and service instead of its enslavement.

Mr. Franklin referred to the necessity of clarifying our concepts of the laws of growth, of change and of evolution, and of obtaining correct and not superficial answers to the questions of what we are making things for or why we are doing them in our present way. An individual or organization which reaches a stage where its sole concern is continuing its own existence is ripe for decay and dissolution. A great industrial city should display relics of its own industrial growth and models which show what has been and can be done. The deficiencies of past utensils have stimulated the desire and attempt to develop new materials which avoid these drawbacks. Referring to the new materials placed at our disposal by metallurgical progress, Mr. Franklin emphasized the importance of cooking utensils, and suggested that the most appropriate materials for such vessels are metals which, if attacked, only yield salts naturally present in the human body, or metals quite immune from attack. He also referred to the way in which care of cleansing should govern the choice of forms, and to the possible future of magnesium alloys in household tools. He looked forward to a world in which good things are efficiently prepared and craftsmen take a worthy place, the right properties being selected for a given purpose, and incorporated in worthy design, in which human personality or individuality is not cramped or repressed. By utilizing in this way for all our purposes the new resources at our disposal and working in this spirit of evolution, we can build up the harmony of life which our civilization is missing.

The Position of the Jews

IN his pamphlet "The Jewish Question" (Oxford Pamphlets on World Affairs, No. 45. Oxford: Clarendon Press. 3*d*. net) Mr. J. Parkes points out that the Jewish problem arises from two sources: the Jewish tradition, which has inculcated in Jews the need to keep themselves separate if they would survive as Jews, and Jewish experience at the hands of the peoples among whom they have lived. Mr. Parkes shows how Jewry has been unfairly identified with all the malpractices of modern commerce and industry and the way in which prejudice, by embittering Jewish experience, has accentuated the minority problem which Jewry might normally present. Modern anti-Semitism has made the problem acute through two main factors: the persecutions in Tsarist Russia at the end of the nineteenth century, which led to the flooding of Western Europe and America with several million Jewish refugees from a totally different level of culture; and the fever of nationalism which spread over the world after the War of 1914–18 and made life difficult for all minorities.

Mr. Parkes considers that the accurate and scientific studies of the question we possess, and our knowledge of the effects of past experience, warrant the view that with planning and co-operation there is nothing in the Jewish problem which need cause pessimism or despair. He suggests that in the light of experience of the last twenty years, a minority is entitled to a communal organization, recognized as a public body, and with control over primary education and teachers' colleges, charitable foundations, and cultural activities, as well as to religious freedom and authority in religious matters where the minority is also a religious minority. On each point the majority has certain rights, for example, in regard to language. Among the Jews themselves, assimilation with their countries of adoption, or the foundation of a Jewish national home have been the main programmes proposed and followed. The basic problem confronting Jews lies in the view which they take of their status: whether they wish to be considered merely a religious minority or a separate national minority. The ultimate problem of Jewry is the rediscovery and reassertion of the fundamental spiritual and social realities of Judaism, to which both assimilation and Zionism are capable of offering soils already prepared.

Bread Flour

PROF. J. REILLY, professor of chemistry in the National University of Ireland (University College, Cork), has produced a booklet entitled "Our Daily Bread" which is particularly interesting at the present time in view of the desirability of making the British Isles less dependent on imports of wheat for its 'daily bread' (Cork: Forum Press. 2s.). He advocates the increased growing of rye, which is hardier than wheat and can be grown on poorer soils, and points out also that oaten and barley flour may without any dietetic disadvantage be used to eke out supplies of wheat. Growers of potatoes should be encouraged to set aside a portion of the crop for the production of potato flour, which is able to furnish us with our carbohydrate needs. It is interesting to note that flour was so scarce in England in 1800 that the Brown Bread Act was passed forbidding the use of pure white wheaten bread, and at this time flour was generally a mixture of equal parts of wheaten and rye flour. Wholemeal bread, of course, in contrast to white bread, contains comparatively large amounts of vitamins and minerals, although this is not the whole of the story.

Origin of Cultivated Water-Melons

ACCORDING to Dr. Orland E. White of the University of Virginia, Africa, not America, is the native land of the water-melon. Speaking before the meeting of the Virginia Academy of Science, he told of recent researches at the Blandy Experimental Farm, which throw new light on the ancestry of this plant. Water-melons were not known at either the Epicurean feasts of ancient Greece or the Lucullan banquets of Rome. Not until the great age of exploration in the sixteenth century do they appear in the world picture. Dr. White is of the opinion that the Portuguese, pushing southward along the coast of Africa, became acquainted with the ancestors of modern water-melons growing wild in South Africa. They soon transferred them to their colony of Brazil, where the Indians promptly adopted them and added them to their own array of crops. Thus the myth of an American origin of water-melons came into being.

Dr. White has obtained seeds of several strains of these small wild South African melons, which have little enough resemblance to the monsters of the modern melon patch. He also has under cultivation stocks of a bitter variety of melon, known as the colocynth, familiar to the ancient Egyptians and other Mediterranean peoples, but used by them only as medicine. He has made many crossings between them and modern cultivated water-melons, some of which may eventually prove commercially valuable.

Phenology of 1940

WITH commendable promptness, the fiftieth Phenological Report of the Royal Meteorological Society, covering 1940, has just been issued despite war-time difficulties making it impossible for the executive committee to meet since the last report. With the exception of a small amount of introductory text, the report consists of a series of tables and diagrams, as has been its increasing trend in recent years. It has the observations of 288 phenological observers in the British Isles, compared with 385 in 1939. The publication of full meteorological details is still restricted, but it includes the events of the historic cold spell early in 1940, probably the coldest January for a hundred years and the sunniest for fifty years. The marked lateness of plants and insects caused by the cold opening of the year gave place to considerable earliness which mainly persisted from the end of April, with a succession of warm, mild spells, and the beauty of spring and early summer was enhanced by the simultaneous occurrence of normally early species which had been retarded and the normally later species which were brought forward.

This recovery also applied to crops, although some autumn-sown cereals failed to survive the winter. The droughty conditions in May, June, and, after a cool showery July, again in August and early September, had an interesting effect upon the grass; in the north-west the assessed condition remained between 77 and 78 per cent throughout August, whereas in the south-east it deteriorated from about 77 per cent to about 56 per cent, during which period the rainfall was about 30 per cent of the average in the north-west but only 3 per cent in the south-east. Indigenous insects are unlikely to have been affected so much as indigenous birds, which, however, had a favourable nesting season after so hard a winter. Migrants arrived at dates not far from average in the south but somewhat later in the north, while the only large-scale insect immigration was that of the large white butterfly (*Pieris brassicæ*). The comparative earliness of the north-west district is shown in the plant and insect diagrams, in advance of the south-east up to May.

Design of Wire Networks Carrying Radio Programmes

IN the *Bell Laboratories Record* of April there is an instructive paper by A. E. Bachelet explaining some of the difficulties encountered when designing wire networks over which radio programmes are transmitted. These in America often form extensive systems with broadcast stations or studios in most of the larger systems interconnected by high-quality circuits employing amplifiers. The transmission over these circuits differs from ordinary telephone transmission in that it is unidirectional, and one-way amplifiers are employed. Since a studio may either transmit or receive programmes, it is necessary to provide means for changing the direction of transmission over the network. In the past this has been done either by using separate facilities which transmit in opposite directions, or by interchanging the input and the output of the amplifiers by the use of switches manually operated.

To provide quicker reversals, a remotely controlled reversing circuit has been developed which permits the reversal of the circuits to be controlled from the studio originating the programme. Reversals are effected by relays, controlled by direct current transmitted over the two conductors of the programme circuit, and returned through the earth. Any studio may assume control and set up the network so as to transmit the programme from it to the other points on the network. As long as this studio retains control, no other studio can alter the conditions. The reversing equipment is required at every amplifier point, which may be a simple amplifier station along the line, or a main junction or terminal connecting to a broadcast studio.

Swiss Electrotechnical Industry during War-time

IN the February issue of *Swiss Technics*, a journal published by the Swiss Office for the Development of Trade (Zurich and Lausanne), which co-operates with the Swiss Association of Machinery Manufacturers, Zurich, there is an instructive account of a visit made to the Secheron Works at Geneva. These works have always been strictly limited to the construction of heavy electrical machinery and material. A few years ago, when the electrification of the chief Swiss railroads, to which the Secheron Works greatly contributed, drew to a close, new lines of manufacture were taken up. Among these was the building of electric welding apparatus and the manufacture of the necessary electrodes. The Secheron alternating-current arc-welding apparatus has now almost everywhere replaced direct-current revolving units. For the welding of complicated parts 'exotherme' electrodes are almost universally employed; cut-out or stamped parts can be simply welded together by the melting of the electrode into the space left between them, thus forming a solid block as homogeneous as a foundry casting.

Enormous alternators for the hydro-electric power station of Verbois are now being constructed at the works. These machines resemble two-storied towers, 9·2 metres high and each weighing 300 tons. All parts are electrically welded and every welding has been carefully inspected by radiograph. At normal speed the peripheral speed of the polar wheel will be equal to 155 km. per hour; at 300 rev. per min. this speed attains 350 km. per hour. A 3,000-h.p. motor is being built for Norway and twelve transformers of 1,000, 2,000 and 3,200 kva. are being built for Ireland.

Electro-formed Reflectors

THE construction recently of 62-in. searchlight reflectors at the Bart Laboratories, New Jersey, shows, according to the *Electrical Review* of April 11, that satisfactory progress is being made in modern electro-forming methods. An electro-formed nickel-surfaced mould is first of all made and a coat of nickel 0·003–0·005 in. thick is applied to the outer passivated nickel face. Then follows a coating of copper, to which a pre-formed bronze ring is applied, and the assembly is given a heavy deposit of copper. These firmly bonded layers are stripped from the mould in the form of a bi-metal reflector with copper on the convex face and nickel on the inner polished face. To prevent the introduction of copper into the rhodium bath, a protective mask is fitted on the copper side. The reflector is now ready to receive its rhodium-plating, and in this instance a 'flash' of rhodium 30 millionths of an inch thick appears satisfactory.

The advantage of this method appears to be in the use of rhodium on a nickel base. It has a high hardness (about 600 Brinell), is tightly adherent to its underlying layer, and also has a high degree of reflectivity and resistance to tarnish. The coatings of rhodium used are exceptionally thin; but as nickel is passive when plated with rhodium, adequate protection is provided. It is stated that full protection is lacking with underlayers of copper and its alloys, the relation of which to rhodium in electro-chemical action is such that disfigurement by corrosion may result.

Japan Institute for the Science of Labour

THE annual report of the Director of the Japan Institute for the Science of Labour for 1939, recently received, in reviewing the present activities of the Institute, emphasizes its objectives in assisting the development of the national industrial capacity, including the training of workers, as well as the improvement of working conditions, and the stimulation of leadership. Reference is made to the investigation of industrial hazards as well as of the problems of agricultural workers, including their maintenance. A somewhat naïve claim is made for the uniqueness of the Institute, as well as a reference to its part in the establishment of a 'New Order' in the Orient. The report also includes the director's address on the "Function and Guiding Spirit of the Institute", given at its first staff conference, in which the character of the Institute as a purely scientific research body covering the daily life of the industrial and agricultural worker is emphasized, and also the importance of its contribution to national productivity and culture. Stress is laid upon the team spirit in the research work of the Institute and its service of social and national needs. Details of the various research sections and laboratories of the Institute are given, as well as of projects already under investigation.

Thin Glass for Microscope Cover-Slips

THE year 1940 marked the centenary of the manufacture in Great Britain of specially thin glass for microscope cover-slips. Prior to this date, it was customary for microscopists to use thin talc or mica for covering specimens to be examined under the microscope. This manufacture was started by Messrs. Chance Brothers and Co., Ltd., at Smethwick, in 1840 as nearly as is known, and has been carried on continuously by the same firm up to the present day. The War has called for a considerable increase in supplies of such glass, both in Great Britain and abroad. There was no essential change in this type of glass until about 1928, when a research was carried out on the development of microscope cover-slips. It was found that the old type of glass, which was essentially like window glass, would not withstand tropical conditions without becoming clouded. Therefore, new methods of manufacturing a glass which would withstand sterilizing and exposure to tropical atmospheres without any deterioration were introduced. The thickness of cover-slip glass is still classified under the headings: Extra thin (0·075–0·100 mm.), No. 1 (0·100–0·167 mm.), No. 2 (0·167–

0·215 mm.), and No. 3 (0·215–0·300 mm.). These correspond closely with the figures quoted in a catalogue issued by the firm in March 1859, which says No. 1 is 1/250 in. in thickness, No. 2 1/160 in., and No. 3 about 1/100 in.

Vital Statistics in Queensland

Out of a total of 9,530 deaths in Queensland in 1939, 2,786 were classified as due to diseases of the heart or circulatory system. Cancer and other tumours were responsible for 1,069, and diseases of the respiratory system for 811. Parasitic and infectious diseases claimed a total of 747, the chief of these being pulmonary tuberculosis (290) and influenza (221). Violent or accidental deaths claimed 812 victims. Out of a mean population of 1,013,000, more than 95,000 received treatment at public hospitals during the year.

Earthquakes Registered at Kew

Between May 18 and June 15, seven large earthquakes were registered by the seismographs at Kew Observatory. These were on May 23 (two), 24 and 30, June 6, 10 and 11. The two shocks on May 23 were from the same epicentre 2,850 km. distant. They commenced with compressional waves at 19h. 57m. 17s. and 22h. 39m. 33s. G.M.T. respectively, and the first attained a maximum ground amplitude at Kew of 24 μ. The shock of May 30 at 21h. 47m. 32s. G.M.T. from 17,000 km. may have had a focal depth of about 400 km. and the shock of June 10 at 20h. 46m. 10s. G.M.T. from 4,900 km. may also have had a deep focus (450 km.). The other shocks were smaller, and all the readings and calculations are tentative.

Earthquake in Baja, California

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, on the basis of reports from fourteen seismograph stations, has found the epicentre of the earthquake of March 15, 1941, at 5h. 46·3m. G.M.T. to be provisionally at latitude 28·1° N., longitude 113·6° W. This is south-west of Calmalli and towards the northern end of the Vizcaino Desert, in an established seismic region.

Wilhelm Preyer (1841–1897)

Prof. Wilhelm Thierry Preyer, a well-known German biochemist and psychologist, was born on July 4, 1841, at Moss Side, Manchester. He studied in Bonn, Heidelberg, Berlin, Vienna and Paris, where he was a pupil of Claude Bernard and Wurtz. In 1869 he was appointed professor of physiology at Jena, where he remained until 1888. He then moved to Berlin, where he served as lecturer until 1893 when he retired, and died at Wiesbaden on July 15, 1897.

Preyer was a prolific writer, first in biochemistry and later in psychology. His biochemical publications were concerned with hæmoglobin and methhæmoglobin (1868), blood acids (1868–70), blood crystals (1871), while his psychological works included the five senses of mankind (1870), the causes of sleep (1877), colour and temperature sense (1881), discovery of hypnotism (1881), and the soul of the child, which went through eight editions (1882–1912).

The Night Sky in July

The moon is full on July 8 at 20·3h. and new on July 24 at 7·7h.U.T. The bright star, Aldebaran (magnitude 1·1), is occulted by the moon on July 20. As seen from Greenwich the predicted time of disappearance is 2h. 47·0m. U.T. at position angle 38° from the north point of the moon's image; the reappearance is at 3h. 34·0m. at position angle 297°. (sunrise is at 4h. 5m.: add 2h. to all times to convert to Midsummer Time). Of the planets visible during this month, Venus is low in the west after sunset and not easily seen. Mars is above the eastern horizon at about 23½h. in mid-July. The gibbous phase of its disk can be seen in a small telescope. The planet is increasing in brightness. Saturn and Jupiter are both morning stars. Saturn is in conjunction with the moon on July 19d. 1h. and Jupiter on July 20d. 9h. After the middle of the month, Mercury may be seen as a morning star, greatest elongation (20° west) occurring on July 24.

Announcements

Sir Henry Dale has announced in a letter in *The Times* the gift by the American Physiological Society of 5,000 dollars to the Royal Society "for the support of British scientific publications, especially in physiology". This is the third gift recently made by American scientific institutions to aid science in Britain; the Rockefeller Institution made a grant for publications (Nature, Feb. 22, p. 237) and the American Philosophical Society has given 10,000 dollars "for the aid of science in Britain" (Nature, April 5, p. 414).

Prof. Frank Horton, professor of physics in the University of London, has been re-elected vice-chancellor of the University for the year 1941–42.

Dr. R. J. W. Le Fevre, lecturer in chemistry at University College, has been appointed reader in the University in respect of that post.

The following doctorates have been conferred: *D.Sc.* on Mr. Bruce Chalmers, of University College, and on Mr. S. G. Clarke, of Battersea Polytechnic; *D.Sc.* (*Economics*) on Mr. S. K. Muranjan, of the London School of Economics.

An Academy of Sciences has been established at Tiflis, Georgia, in connexion with the University.

The Trustees of the Lady Tata Memorial Fund announce that, on the recommendation of the Scientific Advisory Committee, they have agreed, if circumstances permit, to make the following awards for research in blood diseases, with special reference to leukæmia, in the academic year beginning on October 1: Grants for research expenses to Dr. J. Furth (New York), Dr. P. A. Gorer (London) and Dr. A. H. T. Robb-Smith (Oxford); part-time personal grant and grant for research expenses to Dr. W. Jacobson (Cambridge).

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

Quantum Theory of X-Ray Reflexion

In a memoir which appeared in 1926, Laue[1] showed by purely classical reasoning that the X-rays scattered by elastic solid waves of thermal origin in a crystal have the frequency $\nu \pm \nu^*$, ν being the primary X-ray frequency and ν^* the frequency of the elastic waves. He evaluated I_ν and $I_{\nu \pm \nu^*}$, these being respectively the intensities of the reflexion and the scattering by any assigned set of lattice planes in the crystal. The value of $I_{\nu \pm \nu^*}$ for any specified direction of scattering may be found by assigning the appropriate wavelength and orientation to the elastic waves in Laue's formula. The ratio $I_\nu / I_{\nu \pm \nu^*}$ comes out, as might naturally be expected, to be of the order N, this being the total number of atoms in the irradiated solid. Even for a tiny crystal only 1μ in size, the ratio is thus of the order 10^{11}. In other words, the scattering in any specified direction by the lattice planes has an intensity wholly negligible in comparison with that of the coherent reflexion by the same planes.

In an article published in *Current Science* of April 1940, and in a series of three papers following it in the *Proceedings of the Indian Academy of Sciences* for May 1940, experimental evidence was presented showing that the lattice planes in a crystal are capable of giving a second kind of specular reflexion which differs from the reflexions of the classical type in being of a dynamic character and having an altered frequency, besides obeying different geometric laws. Experimental evidence was also presented showing that these reflexions are due to the excitation of the *optical* vibrations of the crystal lattice, and reasons were given for the view that this new type of reflexion is a quantum-mechanical effect.

Other alternative theories of the phenomenon have appeared which, in our view, are neither in accord with accepted physical principles nor with the experimental facts emerging from our investigations. We may, in particular, refer to a view which has been repeatedly expressed[2,3], namely, that the effects observed are diffuse maxima in the scattering of X-rays by elastic waves of thermal origin. This suggestion is, in our opinion, completely contradicted by the observed intensity of the reflexions and their persistence over a large range of settings of the crystal. As shown by our investigations, the intensity ratio between the unmodified and modified reflexions of monochromatic X-rays varies greatly with the crystal, its setting and with the spacing studied; it is generally of the order 1000 : 1, but certainly nothing like 10^{11}. The actual facts of the case can only be understood on the view that we are dealing with the optical vibrations of the crystal lattice; these produce large dynamic variations of the structure amplitudes and negligible distortions of the lattice, unlike the elastic waves, in respect of which the situation is exactly the opposite.

As is well understood at the present time, classical optics and quantum mechanics are mutually complementary and not contradictory. Classical optics indicates that a crystal in which the interpenetrating lattices vibrate with reference to each other would give intense specular reflexions of X-rays with an altered frequency. When, therefore, such an effect is actually observed, it is a legitimate inference that the changes in the energy level of the crystal associated with such a reflexion are to be regarded as induced by the incident radiation itself; in other words, that the intensity of the reflexions is determined by quantum dynamics and not by the classical mechanics. This view led us to predict[4] that the intensity of the modified reflexions by the $\{111\}$ planes of diamond would remain unaffected by cooling the crystal down to liquid air temperatures. This prediction has been completely confirmed by our experiments[5]. Neither the high elasticity of diamond nor the existence of a zero-point energy appear to us to be in any way relevant as an explanation of the observed facts[6].

C. V. Raman.
P. Nilakantan.
P. Rama Pisharoty.

Department of Physics,
Indian Institute of Science,
Bangalore.
May 2.

[1] Laue, *Ann. Phys.*, **81**, 877 (1926).

[2] Zachariasen, *Phys. Rev.*, **57**, 597 (1940).

[3] Lonsdale, Nature, **146**, 806 (1940).

[4] Raman and Nilakantan, *Proc. Ind. Acad. Sci.*, **11**, 396 (1940).

[5] Raman and Nilakantan, Nature, **147**, 119 (1941).

[6] Jahn and Lonsdale, Nature, **147**, 88 (1941).

The Lightning and Spark Discharges

It has recently been pointed out[1] that though the charge leaving the cloud in a lightning flash to earth is probably about half as great again as had hitherto been believed, the potential of the thundercloud base is probably only a few per cent of previous estimates[2]. It already appears[1] that the condition for the occurrence of a flash is not that the breakdown potential be attained over the whole intervening space[2,3], but that a concentration of field should occur of sufficient intensity to initiate what may be called a 'self-propagating' discharge in a field which elsewhere may only reach a few hundred volts per cm. The implications of this are so important in the theory of discharges in general that further confirmation is very desirable. The purpose of this note is to suggest a mechanism to account for the 'darts' of the first leader stroke and the low overall voltage, to direct attention to a characteristic of such discharges which has hitherto been overlooked, and to suggest the condition under which spark breakdown occurs.

One characteristic of the first leader stroke which is nearly always observed is its discontinuous or 'dart'-like appearance[4], which in my opinion has not so far been satisfactorily accounted for. The explanation now proposed is that the *'darts' represent the sudden transition of newly formed portions of the* *advancing streamer from glow to arc conditions.* As the streamer advances, an increasing current must flow through the tip of the preceding dart to maintain the increasing lateral or corona current from the sides of the streamer. When this current, together with the small current involved in the vertical progression of the tip, builds up to the order of one or a few amperes, sudden transition from glow to arc will occur[5,6,7]. The order of magnitude at least of the current attained when the streamer reaches a length of 7–10 metres, and the average length of the darts, can be estimated from the charge neutralized in the atmosphere by the average lightning flash, namely, about 10 coulombs, of which about half is probably neutralized during the first leader stroke[1]. From the duration of the leader stroke, say 10^{-2} sec., and the length of the lightning channel, say 2·5 km., this neutralization requires a lateral current of the order of 4×10^{-3} amp. per cm. length of channel, or 3–4 amp. over the length of a dart. Allowance for the branching of the first stroke would merely reduce this current by a factor of about 3, so that this current is in good agreement with that for which glow - arc transition occurs.

Further support is derived from a consideration of the transition from arc back to glow. This occurs for a current which is about 10 per cent of that required for glow - arc transition[7], so that arc conditions would not be maintained in the last tenth of the dart length, which would therefore be re-illuminated by the succeeding dart, just as has been actually observed by Schonland[4]. Again, Allibone and Meek[8] observed that currents of the same order flowed during the leader stroke of the spark discharge, and it is interesting to observe that, owing to their rapidly varying nature, the currents in the leader strokes in this case were often greater than those of the subsequent return strokes, a conclusion supported by the relative photographic intensities of the two strokes.

Such an arc channel can be regarded simply as an extension of the initiating conductor, and the voltage gradient along it is only of the order of 10 volts per cm. These considerations explain the 'self-propagating' nature of the discharge and the large charge neutralized by the corona, which is thus seen to be an important, though hitherto unrecognized, feature of the discharge.

The condition for the occurrence of a spark in a non-homogeneous field would thus appear to be that *the current in the brush discharge from an electrode should be sufficient to cause glow - arc transition to occur*, after which the leader progresses by the above mechanism.

A more detailed account of this work will be published shortly.

C. E. R. BRUCE.

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May 29.

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[1] Bruce, C. E. R., and Golde, R. H., *J. Inst. Elect. Eng.* (in press).

[2] Wilson, C. T. R., *Phil. Trans. Roy. Soc.*, **221**, 73 (1921).

[3] Meek, J. M., *Phys. Rev.*, **55**, 972 (May 15, 1939).

[4] Schonland, B. F. J., Malan, D. J., and Collens, H., *Proc. Roy. Soc.*, A, **152**, 595 (1935).

[5] Todd, F. C., and Browne, T. E., *Phys. Rev.*, **36**, 732 (Aug. 15, 1930).

[6] Fan, H. Y., *Phys. Rev.*, **55**, 769 (April 15, 1939).

[7] Attwood, S. S., Dow, W. G., and Krausnick, W., *Trans. Amer. Inst. Elect. Eng.*, **50** (3), 854 (Sept., 1931).

[8] Allibone, T. E., and Meek, J. M., *Proc. Roy. Soc.*, A, **166**, 97 (1939).

An Effect of Light in Gases under Electrical Discharge

THE observation reported previously[1], namely, an instantaneous diminution of the discharge current in chlorine on irradiation, has now been extended to other gases subjected to ionization by collision in electric fields due to alternating potentials in Siemens' tubes.

It is observed that the photo-variation of the discharge current varies rapidly in the order: chlorine, bromine, hydrochloric acid gas, iodine. In fact, observation of the effect in iodine is nearly impossible without a sensitive indicator and adequate irradiation. Furthermore, especially in the case of iodine, the photo-effect is easily masked by a dark, in part, 'ageing' effect, that is, a time-variation of the discharge current produced under a constant applied potential; this varies in the order: iodine, bromine, chlorine. Other conditions remaining the same, a rise in the gas pressure and temperature tends to diminish the light-effect; an increase in the applied potential, frequency of the A.C. supply and of the external radiation employed, as also its intensity, increases it.

Preliminary experiments have shown that differences in the magnitude of the light-effect in chlorine using plane polarized and equally intense ordinary light lie within the margin of probable experimental error.

The use of larger discharge tubes, radiation of much greater intensity and of shorter wave-length, and of specially sensitive current indicators has revealed the effect in oxygen, air, nitrogen and hydrogen; its magnitude is, however, very considerably smaller in these gases than in the case of the halogens.

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G. S. DESHMUKH.

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Benares Hindu University.

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[1] *Current Science*, 9, 535–537 (1940).

Pigmentary Changes and the Background Response in Amphibia

THE results of recent experiments of mine have shown that our conception of the nature of the background response in Amphibia is inadequate and must be extended. When *Rana temporaria* is kept on an illuminated black background for several weeks, melanin granules are dispersed in the melanophores and the amount of melanin in the skin is increased. Conversely, when the animal is kept on a white background, melanin granules are aggregated in the pigment cells and the amount of melanin in the skin is decreased. In short, additive and subtractive processes are operative. Both effects have been observed by means of photometric determinations of solutions of melanin extracted from the skin, and the latter effect is apparent microscopically in the degeneration of melanophores[1].

Other experiments of mine have tended to show that the amount of melanin in the retinal pigment epithelium of *Rana temporaria* varies under certain conditions. When the eye has received the radiations from a Hanovia lamp, melanin granules may be densely aggregated at the same time in both the basal regions and the processes of the retinal pigment cells. A condition thus arises which is not ogical and which combines the pigmentary ers of both the dark- and the light-adapted or this and other reasons, the idea of pigment on in the retina has been criticized and it has uggested that whether or not actual movement nules occurs as a result of cytoplasmic streaming as has been postulated, other processes are bably at work. One possibility is the concomitant aching or destruction of pigment and colour ensification or the development of pigment in fferent parts of the pigment cells[2].

Since my papers went to press, I have discovered the literature facts which have some bearing on y work and which deserve brief comment. Figge[3] epeated the experiments of Lewis[4] on the development of pallor in the larvæ of amphibians reared in solutions of dyes which are also oxidation-reduction indicators. Pallor seemed to imply the destruction of melanin, but was found to arise in consequence of the inhibition of tyrosinase action by the dye[5]. Tyrosinase is regulated by oxidation-reduction potenials, and in a mixture of melanin with redox inditors, sodium hydrosulphite not only decolorizes the e but also alters black melanin to a light brown lour. The subsequent addition of potassium ferrianide to the mixture reverses the change and tores to the pigment its former black colour. ge concluded that melanin is a natural reversible idation-reduction system.[6]

Natural melanin, like the pigment produced by oxidation of dihydroxyphenylalanine (dopa), is pable of reversible oxidation and reduction, but e reaction is far more sluggish and barely pereptible, perhaps because of the low concentrations used in the tests and of contaminants in the reaction mixture. The pure melanin which occurs in the ink of the squid *Loligo pealii* was found to be almost as reactive as dopa melanin and capable likewise of alternate oxidation and reduction repeatedly with corresponding colour change and without significant final loss of colour[7].

These facts suggest that the pallor which is due to the white background response may involve alteration rather than actual degradation of melanin. If such pallor is due to the inhibition of tyrosinase action, however, the loss of melanin can be explained on the assumption that under conditions of neutral background the pigment is being both produced and excreted or otherwise lost continually, and that under conditions of white background melanogenesis is suspended while the excretion of melanin continues. Some pigment must be lost at all times and under all conditions by moulting of the epidermis, and unpublished observations of mine show that more is lost by this means in dark than in pale animals. From this it seems likely that under conditions of black background melanogenesis is heightened even more considerably than the experimental data in my earlier paper suggest.

If apparent loss of melanin under conditions of white background is due even in part to discharge of the black colour by alteration of melanin, the observations of Figge suggest that the cause is to be sought in oxidation-reduction processes of pigmented tissues. Such a possibility was in fact in my mind when I made the suggestion of bleaching and darkenng processes as an alternative to the idea of pigment migration in the retinal pigment epithelium. It now ems likely also in regard to the skin and other es in which melanin is to be found.

A further possibility presents itself, namely, the interaction of melanin and/or its precursors (at least two of which are capable of reversible oxidation and reduction) with other systems of similar nature, notably lyochromes but also carotenoids. It seems significant that lactoflavin is accumulated in the pigment epithelium of the perch retina[8], and that in non-scaly fishes like the eel the melanophores of the skin have a high flavin content[9]. If melanin and its precursors are functionally related to such important systems as the flavoproteins and carotenoids, pigmentary changes in the skin and the retina acquire physiological significance and the occurrence of melanophores in the walls of blood capillaries, the membranes of central nervous organs, and the other deep situations in which they seem incongruous is less enigmatical.

BEN DAWES.

King's College, London
(at the University of Bristol). June 5.

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[1] Dawes, B., *J. Exp. Biol.*, 18, 26 (1941) (I should like to express my regret at the misspelling in this paper of the name Vilter).
[2] Dawes, B., *J. Exp. Biol.* (in the press).
[3] Figge, F. H. J., *J. Exp. Zool.*, 78, 471 (1938).
[4] Lewis, M. R., *J. Exp. Zool.*, 64, 57 (1932).
[5] Figge, F. H. J., *Proc. Soc. Exp. Biol. and Med.*, 39, 569 (1938).
[6] Figge, F. H. J., *Proc. Soc. Exp. Biol. and Med.*, 41, 127 (1939).
[7] Figge, F. H. J., *Proc. Soc. Exp. Biol. and Med.*, 44, 293 (1940).
[8] Zewi, M., *Finska Läksällsk. Handb.*, 80, 923 (1937).
[9] Fontaine, M., and Busnel, R. S., *C.R.*, 206, 372 (1938).

"Vegetables as Food"

Drs. Booth, Mapson and Moore[1] feel that in a recent article in Nature[2] I exaggerated when I made "an allusion, divorced from its context, to cooked cabbage as having only 17 per cent of the vitamin C of the fresh cabbage". What I wrote was as follows. "A cabbage bought at the market may perhaps be expected to contain 60 per cent of its original vitamin C content, the housewife probably throws away no more than 20 per cent of the remainder in preparing the vegetable for the pot, leaving 40 per cent [more correctly 48 per cent] of the original vitamin. During boiling, however, . . . about 65 per cent is extracted by the cooking water and usually thrown away. Thus 17 per cent of the vitamin C with which the cabbage left the field is all that remains when it reaches the table."

I still believe this statement to be substantially true. When the urban housewife buys her cabbage it may be some days old, and loss of freshness carries with it loss of vitamin C. After she has bought it, part at least may be stored for a further period in her larder or kitchen, where further loss occurs. Miss Olliver, in an address of which my article was in part a review, showed that only 37 per cent of the original vitamin C may remain in shop-purchased cabbage, although, as she also shows, there may in better circumstances be no loss at all. I do not therefore feel that my figure of 60 per cent is unfair. My next figure of 20 per cent loss in preparing the vegetable for the pot is admittedly an estimate, but bearing in mind that the heavy outside leaves which are discarded are richest in vitamin C, I hoped it was not unreasonable. The losses of the remaining vitamin during boiling shown in Miss Olliver's tables which she had kindly made available to me were as follows:

Cabbage: 62, 62, 61, 69*, 66, 53, 66 per cent.
Kale: 67, 46, 77*, 76*, 78*, 71*, 84 per cent.

* Probably normal method of cooking.

I am aware that losses of the order of 40–50 per cent can be achieved, and in agreement with the Cambridge workers I myself have obtained figures as low as 20 per cent. The bulk of the evidence seems to show, however, that, in general, losses of vitamin C are very high.

Dr. Booth and his colleagues will receive the thanks of all workers in nutrition for their figures for carotene in carrots. Anyone who has occasion to use published tables of carotene values knows the bewilderment of choosing from a confusion of figures often differing many fold. But while the position of vegetables as sources of carotene and hence of vitamin A available to the body has not yet been completely elucidated, the standing of green vegetables as a source of vitamin C is beyond dispute. As Miss Olliver and Mr. Adam truly state[3] they "can adequately supply the full daily requirement of the vitamin". This they do, I cannot help believing, only after the bulk of the vitamin supplied by bountiful Nature has been lost. Can we afford to lose so much in present times ?

Vitamins Ltd.,
London, W.6.

AGNUS PYKE.

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[1] NATURE, **147**, 711 (1941).

[2] Pyke, M., NATURE, **147**, 513 (1941).

[3] NATURE, **147**, 711 (1941).

Whilst it is an accepted fact that there may be considerable wastage of vitamin C when vegetables are cooked, any statement which tends to underestimate the antiscorbutic value of cooked vegetables is to be deprecated.

Dr. Pyke's original article tends to give this impression, and it is unfortunate that such an impression should be confirmed by the choice in the above letter of figures separated from their context.

M. OLLIVER.

Science and Society

HITHERTO most apologists for science have done little more than stress the potential value of aspects of technology, such as would provide new foods, weapons and other *things*. Until recently this was the only non-cultural justification of science, but to maintain it now is out of date.

Our society may be likened to a badly run office, the directors of which are ready to call in a tradesman to stop a leak obvious to the senses, but have no idea of using intelligence and skill of another order to put a stop to ineffective methods in the running of the office itself. Let not men of science put themselves in the position of forming only a works and repairs department of the office, with no concern except to press for more and better plumbing, or to suggest that it need not be confined to repairs.

The politician, a victim of his education, is unaware of common scientific concepts such as limiting values and the elementary theory of errors. It appears that his notions of equilibria are represented by arithmetical averages in a static two-phase system, and that he can conceive of no interactions more complex than those of a game of chess—in which one piece is moved at a time. The chances are even that subjective decisions will be wrong ; nor is any test of their validity possible.

As a result of work in the field of mathematical statistics, our generation is the first to have the power of applying objective tests to many social problems. To this ability is added the pra
of assessing the validity of the results.
thought applied to such matters as the
and evacuation could have avoided their
and lessened the harm done to our nationa
Unfortunately, it was not officially realized th
problems were amenable to objective methods.

The new discipline has been developed prim
in Britain and secondarily in the United States.
is little known on the Continent and is not use
all in Germany or Italy. I suggest that its incor
tion into our social methods might well be our a
to the apparent German monopoly of positive ide

35 Tennyson Road,
Harpenden, Herts.

HUGH NICO

Infestation of Manufactured Food by Insects

DR. D. N. ROY's letter in NATURE of Jun
p. 746, suggests that the special problem to
he refers is something apart from the problems
I described in my report to the Departme
Scientific and Industrial Research. In fact, it is
kind of problem to which I directed attention.

Some years ago, considerable time and stud
given in my department to the cause of infest
of a manufactured commodity similar to, if
identical with, that referred to by Dr. Roy.
conclusion reached was that as precautions had
taken to ensure bottling of the commodity
sterile conditions the method of sealing was at fa
In the course of the investigation, evidence wa
obtained that infestation might occur at almost any point in the marketing of the commodity, and that a most likely point or focus of infestation was the Indian go-downs in which, according to reports
received, the beetles Silvanus and Tribolium wer
abundant.

Imperial College of Science
and Technology,
London, S.W.7.

J. W. MUNR

"Plankton as a Source of Food"

THERE is one point which I should like to add to Prof. Hardy's article on "Plankton as a Source of Food"[1]. He is concerned chiefly, and rightly so, with marine plankton. Would it not be possible to make use also of the freshwater plankton from our lakes and reservoirs ? In this connexion I may refer to
statement by (the late) C. H. H. Harold[2], that a certain reservoir was estimated to contain 10,80
tons (wet weight) of algæ ; and even allowing tha
that estimate is somewhat of an exaggeration, a
appreciable quantity must have been present, for h
goes on to say that 90 tons were removed daily b
filtration. More recently, Gardiner[3] speaks of
reservoir having, at the spring maximum, a crop
Fragilaria crotonensis estimated at a dry weight
110 tons. It would seem, therefore, that here,
least, is ample material for investigation.

Department of Biochemistry,
University Museum,
Oxford. June 13.

E. WALKER.

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[1] NATURE, **147**, 695 (1941).

[2] Proc. Second Inter. Congress for Microbiology (London, 1936)

[3] *Ann. App. Biol.*, Proc. Assoc. of Applied Biologists, **26**, 165

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RESEARCH ITEMS

n of Sex Chromosomes

J. D. WHITE (*J. Gen.*, **42**, 143–172 and 173–190 ; .) has examined the sex-chromosome mechanisms raying mantids and in the crickets and grass- ors. The majority of the Mantoidea have an *XX* sex chromosome mechanism ; the *X*- posome is mediocentric. In the sub-family tiniæ *sensu stricto* a $X_1X_2Y_1 : X_1X_1X_2X_2$ mech- m has been developed. The author shows that probably arose from the *XO* type by a mutual translocation between the *X* and an autosome. The sizes of the component chromosomes may differ as the result of succeeding translocations. Meiosis ppears to be of an anomalous type, and it would eem impossible to determine by cytological methods her crossing-over occurs, since chiasmata are not . It is shown that translocation simultaneously ving both *X* and autosomes in the Tettigondæ s rarely if at all. The *X* is therefore in evolu- ry isolation. Therefore differences in sizes and e of the *X*-chromosomes of neighbouring genera arisen from internal rearrangements. These ngements may be beneficial in readjusting balance, upon which sex determination depends.

n of Cherries

RAPTOPOULOS (*J. Gen.*, **42**, 91–113 ; 1941) has ined the cytological behaviour of Duke, sour d sweet cherries and several hybrids. He shows hat the Duke cherries and the sour cherries are autotetraploids, but of different origins. The Duke herry probably is a tetraploid derivative of *Prunus vium*, whereas the sour cherries probably arose om a species cognate to *Prunus avium* which ered in a number of genetic characters. The ntitative data on which the above conclusions based are that the Duke cherries have a high sma frequency (1·59) while the sour cherries ave a lower frequency (1·34). When crossed together, the sour cherries are able to produce as many quadrivalent configurations as in the Dukes themselves. Hence selection has taken place in the sour cherry for low chiasma frequency. There is an nverse ratio between fertility and number of quadrivalents in nine species and varieties of tetraploid herries.

ltra-Violet Absorption by *Drosophila melanogaster*

SINCE ultra-violet radiation gives rise to lethal gene utations in Drosophila, it is important to know how uch radiation penetrates the body cells before aching the sperms. As a first approximation, Durand, A. Hollaender and M. B. Houlahon . *Hered.*, **32**, 5'–56 ; 1941) have observed the sorption of radiation by the abdominal wall tween 2140 A. and 4400 A. under an ultra-violet croscope. It was found that the abdominal wall unexpectedly transparent. Below 3000 A. there is rapid increase in absorption ; this ranges from ut 20 per cent at 4400 A. to about 94 per cent at A. It is necessary, therefore, to know the nt of absorption in the overlying tissue in to know the dose which induces gene mutation testis.

Wing Development in Drosophila

MANY genes affect the characters of *Drosophila melanogaster*, and, as shown by Waddington, these affect the wing at different stages of development. A. D. Lees (*J. Gen.*, **42**, 115–142 ; 1941) has wounded the developing wing of pupæ 0–3½ hours old, 4-6 hours old and 6–21 hours old. Wounding the wings of the youngest pupæ gave rise to tilt, fused, vesiculation and scalloping effects. Wounding of the 4-hour-old pupæ gives characteristic rounded wings due to an inhibition of cell multiplication and to the dumpy effect. Injury of the older pupæ leads to holes in the epithelium, to production of extra veins as in Delta, and alteration of the position of the posterior cross vein. These experiments shed considerable light on the means by which one gene may affect a final character expression by disturbance of the normal development at a particular stage.

Behaviour of Nitrogen and Hydrogen on Osmium

HABER in his classical researches on the synthesis of ammonia found that osmium was an excellent catalyst. The catalysts for this important synthesis have commanded much attention. Recently H. S. Taylor and Joris have investigated the exchange of nitrogen isotopes on a promoted iron catalyst, and they have now extended their studies to an unpromoted, metallic osmium catalyst (*J. Chem. Physics*, **9**, 287 ; 1941), prepared by the decomposition-reduction of ammonium osmium chloride in a stream of hydrogen at 300° C. Activated adsorption of hydrogen on osmium occurs between 80° and 573° K., but at low temperatures a certain amount of van der Waals' adsorption is also evident. With nitrogen, throughout the same temperature range, van der Waals' adsorption decreases as the temperature is increased. The isobar at 1 atmosphere shows a minimum at 350° and then increases, due to activated adsorption, to a maximum at 428°. The nitrogen adsorption is less than 10 per cent of the hydrogen adsorption at one atmosphere between 273° and 573°. At 473° the isotopic exchange of nitrogen, $^{28}N_2 + {}^{30}N_2 = 2\,{}^{29}N_2$, is just measurable, but at 573° it is very rapid and has an activation energy of 21·8 kgm.cal. The reaction is inhibited by hydrogen and becomes unmeasurable when the hydrogen content exceeds 50 per cent. Ammonia decomposes six times as fast as the rate of the exchange reaction and yields a 1 : 3 nitrogen-hydrogen mixture. The mechanism of the exchange appears to be controlled by the migration of atomically bound nitrogen on a surface on which active centres are few. The area per gram of osmium has been calculated as 30·8 square metres, but only 4 per cent of this area is covered by nitrogen at the temperature of maximum activated adsorption (428°).

Optically Active Dyes

THE present view of the mechanism of the dyeing of textile fibres is that it occurs in three stages : (1) diffusion of the dye into the submicroscopic voids of the fibre, (2) adsorption of the dye, (3) irreversible fixation of the dye. The nature of the union between the dye molecule and fibre molecule is not established, but it is generally supposed to be a physical adsorptive phenomenon occurring through hydrogen bonds and secondary valencies in the dyeing of vegetable fibres, and chemical phenomena such as salt formation in the dyeing of animal fibres. But the distinction between these two types of combination is not sharp, and the process might be the result of both. Some slight evidence of optically selective adsorption of one form of a dye containing an asymmetric carbon atom, claimed by Morgan and Skinner in 1925, has not been substantiated, so that the partial resolution of a dye in the racemic form in associating with the optically active structure of protein and cellulose fibres, which would favour a chemical combination, is not proved. W. R. Brode and R. E. Brooks (*J. Amer. Chem. Soc.*, **63**, 923; 1941) have now synthesized a dye in which the whole molecule, and not merely a carbon atom well removed from the origin of colour, is asymmetric, and the chromophore and auxochrome groups are situated as nearly as possible to the seat of optical activity. It was prepared by tetrazotization of the active and racemic forms of 2, 2′-diamino-1, 1′- dinaphythyl and coupling with phenyl-*J*-acid. Dyeing tests with these active and racemic dyes failed to show any selective absorption by wool or rayon fibres, and support a physical, rather than a chemical, combination between fibre and dyestuff.

Vapour Density of Iodine

AT ordinary temperatures, iodine consists of diatomic molecules. At 600° dissociation is less than 1 per cent, but at 1200° it is 50 per cent. The equilibrium $I_2 \rightleftarrows 2I$ has been previously investigated several times, but there is a lack of concordance among the data. A re-examination has been made by G. K. Rollefson and Perlman (*J. Chem. Physics*, **9**, 362; 1941) in order to obtain reliable data and to test experimentally if existing difficulties arise from the presence of triatomic molecules, which, on theoretical grounds, are considered sufficiently stable to exist in the vapour state (*J. Amer. Chem. Soc.*, **54**, 170; 1932). The pressure – volume products of iodine vapour were measured between 723° and 1274° K. In this region iodine vapour contains no trace of triatomic molecules, but is an equilibrium mixture of I_2 and I. From equilibrium constants and known energy levels of I_2 and I, the heat of dissociation of iodine is 35,514 ± 50 gm.cal., in close agreement with the value obtained directly from spectroscopic data.

Design of Joint Boxes for Super-Tension Cables

C. E. ROSE has published a useful practical paper on the design of a joint for splicing together consecutive cable-lengths or for connecting up cables to station switchgear (*Eng. Supp., Siemens Mag.*, No. 292, 1941). One of the main causes of trouble results from the expansion caused by the temperature effects of the load. The expansion of insulating compound used in joints is of the order of about 3 per cent over the usual working temperature range. Cable oil expands to an even greater extent when the conductors are carrying heavy loads, exerting pressure on the lead sheaths and sealing ends, and so tends to penetrate the joint boxes. When solid compounds are used for filling the joints and end boxes, up to 11 kilovolt working voltage, a high melting-point solid-setting compound of bituminous nature is usually employed. This tends to act as a bar
to the flow of cable oil. Provision has to be ma
the end boxes for the expansion of this compo
and also for the seeping of the cable oil, which
soften the solid compound in places where they c
into contact. For voltages greater than 11 kilov
a compound of a semi-fluid nature with a si
constitution to that of the cable impregnating
used for filling joint sleeves and end boxes. E
all boxes used for these compounds must be per
oil-tight. Where steep gradients occur in the
route, it may be advisable to stop the interch
of compound between the cable and the joint
to isolate each length of cable on a slope. This
limit the pressure set up at the lower end of e
cable length, and prevent undue draining of the ca
oil. These joints are known as barrier joints
virtually comprise a double-end box, each c
terminating on either side of the barrier plate.

Limits of Uniform Galactic Absorption

THE results of investigations on the questio
general galactic absorption have been rather
cordant. This is partly due to the recogn
irregular distribution of the absorbing matter, pa
to the uncertainty about the distances of the s
and partly to the non-homogeneous working mat
which includes early stars, late stars, Cepheids,
clusters, etc. George Alter has now shown that
uniform and continuous absorbing galactic lay
is possible to determine the absorbing condition
the observed relation between colour index
absolute magnitude (*Mon. Not. Roy. Astro. Soc.*,
2; 1941). An investigation is made on the li
for the photovisual, photographic and selec
absorption coefficients, and the two assumption
this investigation are based on experience. I
additional theoretical assumption is made, the s
tive law, derived by Stebbins, Huffer and Whit
these limits are restricted further. Some sugges
are made for the determination of the actual c
cients. One of these is that the absorption c
tions in the 'galactic windows' might be car
investigated, the influence of absorbing clouds
thus avoided so far as possible.

Stellar Lithium

RECENT theories of energy generation in the c
stars (see, for example, NATURE, **144**, 575;
postulate the interaction of protons and the n
of light elements such as lithium in stellar inte
Until now the only extra-terrestrial evidence for
existence of lithium atoms has been the faint o
rence in the solar spectrum of the resonance d
of neutral lithium at 6708 A., the lithium ana
of the sodium *D* lines. Now, however, Dr.
McKellar reports (*Observatory*, **64**, 4; 1941) that
doublet occurs strongly in the spectrum of the *N*-
giant variable star *WZ* Cassiopeiæ, being seco
intensity only to the *D* lines themselves. A puz
feature of the discovery is that this star is a
among the ten or more *R*- and *N*-type stars e
ined by McKellar in showing the lithium lines;
in other respects, such as absolute magnitude
radius, it does not appear abnormal. Astrophysi
are always loth to attribute abnormal strength
spectral line to abnormal abundance of the em
element, but the facts here do seem to sugges
lithium is unusually abundant in the atmosphe
this particular star.

THE ROCKEFELLER FOUNDATION

N his review of the work of the Rockefeller Foundation in 1940, the president, Dr. Raymond B. dick, refers to the limitation of the Foundation's k through the extension of the War. Projects in way, Belgium, Holland, Denmark, France and mania could no longer be assisted, but in spite of s interference, 23 per cent of the Rockefeller undation appropriations of 9,854,497 dollars during year were spent abroad in forty-four countries Europe, Asia, Africa and the Americas in six ajor fields—public health, natural sciences, social iences, medical sciences, humanities and rural construction in China. Early in July 1940, a ealth Commission to Europe was organized, and r. Willow A. Sawyer, director of the International ealth Division, made two extended trips to rope, visiting France, England, Spain and Portugal. bacteriologist-epidemiologist has been sent to ngland at the request of the Ministry of Health to udy the influenza problem, and plans are under ay to send one or more experts in nutrition and a ecialist in typhus fever to Spain, and a bacteriolog--epidemiologist to France. Restrictions of com-unications between Europe and America have verely limited the development of this programme, t Dr. Fosdick refers to work in the Foundation's boratories under Dr. F. L. Horsfall on the velopment of a satisfactory anti-influenza vaccine. is hoped that by the winter of 1941–42 an experi-ntal vaccine will be available which can be applied at least three different types of the influenza isease.

The report gives further details of the progress of e campaign against the *Anopheles gambiæ* mosquito Brazil, which has now restricted the activities of this fly to the low Jaguaribe valley, and it appears possible to contemplate its eradication from Brazil. Investigations on yellow fever in Colombia suggest that it is primarily a disease of jungle animals, transmission from man to man by the *Ædes ægypti* mosquito being a secondary cycle depending on population conditions and mosquito breeding created by man himself. Transmission of jungle yellow fever appears to be by jungle mosquitoes from animal to animal, and there is no animal reservoir of virus in the usual sense. Vaccination of the population in contact with the infected forest area is the most important measure of control. The Foundation supplied 250,000 doses of its yellow fever vaccine to the Sudan at the request of the British Government to deal with a sharp outbreak of the fever in the Nubian mountains.

A new school of public health is being developed at the University of Michigan with a grant of 500,000 dollars from the Foundation and a similar sum from the W. K. Kellogg Foundation. Most of the appropriations in medical sciences in 1940 relate to teaching and research in psychiatry, neurology and psychology or preventive medicine. Reference is also made to the new giant cyclotron under construction at Berkeley, California, and its significance as an expression of man's hunger for knowledge and unassuageable search for truth. Here, as in his references to science and the moral order, to the challenge to the social sciences, to refugee scientific workers and the conditions in European universities, Dr. Fosdick once more reveals his appreciation of the way in which freedom and scholarship, science and learning, are bound up with the success of the cause of democracy.

SEASONAL RHYTHM OF A FLY

By Dr. Ll. Lloyd,

University of Leeds

PROLONGED and uniform trapping of the flies emerging from the bacteria beds of sewage works t Leeds has demonstrated a type of seasonal rhythm t is probably common in rapidly breeding insects. *aniotoma minima* Mg. (Chironomidæ) prevails hroughout the year, and during eight years of ollecting has appeared in almost every week. It is a minimum about April, increases to a maximum August or September and then declines rather owly. On the basis of the monthly totals the umerical change is steady and the curve of incidence moulded partly by the progress-temperature law d partly by the pressure of competing species[1]. If e weekly catches from the traps are considered, it seen that whether the general seasonal abundance low or high there are peak periods of emergence, hallow and obtuse in winter, sharp and abrupt in mmer, abrupt and with a tendency to be flat-pped in autumn. There is evidently a periodicity these peaks and the interval is less than that required for a complete life-cycle. An analysis of the figures shows that successions of generations are running, always two and sometimes three.

One such succession, *A*, has been traced through seventeen generations from November 13–17, 1937, to October 14–21, 1940, when it reaches a flat-topped peak which splits. Another succession, *B*, has been traced through nine generations from October 23, 1937, to the summer of 1939, when it loses itself in *A*. A third, *C*, has been traced from December 17, 1938, when it has its origin in *B*, through eight generations to November 6, 1940. *A*, *B* and *C* run distinctly and parallel through almost one year. A portion of the record where *A* and *C* are running is shown in the accompanying table.

The generations have been traced by means of the daily average bed temperature and the thermal constants, the theoretical thresholds and required accumulations of day-degrees (*F*.) for the four phases of the cycle being as follows: maturation of the

ALTERNATION OF A SUCCESSION OF TWO GENERATIONS, *A* AND *C* OF A FLY (*Spaniotoma minima*) AND A SIMILAR SERIES *a* AND *b* OBTAINED BY THEORY FROM AN ORIGINALLY UNIFORM POPULATION. TRAPPING NUMBERS ARE IN HUNDREDS.

1940		Trapping	Theory	1940		Trapping	Theory
March	6	0·6	0	July	3	5·3	5
	13	0·7	1		10	5·3	8 *b*
	20	0·6	0		17	12·5	3
	27	1·3 *C*	5 *a*		24	48·0 *C*	5
April	3	1·3 *C*	6 *a*		31	15·0	15 *a*
	10	0·2	1	Aug.	7	38·0	8
	17	0·02	2		14	58·4 *A*	7
	24	0·09	4		21	59·3 *A*	2
May	1	0·4	3		28	24·1	8 *b*
	8	2·3	7	Sept.	4	74·3 *C*	6
	15	4·7 *A*	6		11	63·5 *C*	9 *a*
	22	0·3	1		18	35·0	5
	29	2·8	8 *b*		25	35·4	5
June	5	15·2 *C*	3	Oct.	2	72·2 *A*	3
	12	12·2 *C*	14 *a*		9	51·1	6
	19	4·9	8		16	72·2 *A*	0
	26	6·3 *A*	8		23	56·1	2

female, 32/113·5° ; incubation of the egg, 39·5/68·5° ; growth of the larva, 38·5/689·5° ; pupation, 42/66·5°[2]. The longest cycle observed is 159 days, the theory demanding 146 days ; the shortest is 38 days, theory demanding 32 days. Tracing from peak to peak, the average error in 31 calculations is about 7 per cent, 26 being longer than theory demands while 5 are shorter. Of the former 18 are 1–7 days beyond expectation, and these are substantially accurate since the collections of flies cover the emergence of one week. The behaviour of the insect thus covers expectation very well, and by means of a theoretical case it is possible to show the mechanism that produces the successions.

A uniform population of one unit a day has been imagined from August 7 to September 21, 1937, and it is supposed that their environment has the atmospheric shade temperature of the locality in order to get a sharper contrast and a quicker result than the equable bed temperatures would afford. Offspring from August 7 are due on September 22, so a complete generation has been covered. At first of course the units tend to scatter and regather as spring comes on and in doing so they tend to cluster until by July 1938 a group of six units has clustered for emergence on one day. By July 1939 a second group of six units has formed separated from the first by an interval of 14 days. Three other groups of four units each have also formed, the rest remaining scattered or in twos. By 1940 the population, assessed weekly, has assumed a form strikingly like that of the fly in Nature. Part of the record is shown in the table with the generation intervals marked *a* . . . *a* and *b* . . . *b*. It seems likely tha if the calculation were carried through a sufficie number of years the original forty-six units would aggregate into two or three isolated groups. Suc an abrupt result could not obtain in Nature partly because a family spreads itself over several days in emergence and partly because of the reversal process

Moderately abrupt temperature changes extendin over a few days near the beginning or near the end o the cycle are responsible for the phenomenon. The spring rises especially tend to cluster the offspring whose parents were widely separated in time. Once a distinctive peak is formed it persists until it happens to be involved in such a change. Sudden temperature falls in autumn especially tend to split the flat-topped peaks mentioned above. In the table, for example, the flies of August 14 just avoid a temperature fall which envelops the second half of the peak on August 21. The result is that a saddle-backed peak develops on October 2–9–16. The split persists in the present year.

It seems imperative that a rapidly breeding insect the speed of development of which is governed solely by the progress-temperature law must behave in this way. *Psychoda alternata*, which also breeds in bacteria beds certainly does so, and its case is being examined in detail. Many insects have their seasonal incidence regulated by the 'diapause', a coma-like state instituted at some suitable point in the life-cycle by ancestral experience of the weather of the average year and calculated to terminate at a time when conditions should be favourable. Sometimes the diapause persists until a second or third favourable season should be due. Thus the likelihood of extermination through an unfavourable season is reduced. The commoner sewage flies show no such phase, but the mechanism here demonstrated and wholely dependent on physico-chemical regulation would seem to serve the same end. *S. minima* requires fairly mild calm weather for the mating dance. A single flight might be unable to achieve mating through encountering a cold stormy period. Repetition of the flight with an interval makes disaster through these means much less likely.

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[1] Lloyd, Ll., Graham, J. F., and Reynoldson, T.B., *Ann. App. Biol.* 27, 122 (1940).

[2] Lloyd, Ll., *J. Proc. Inst. Sewage Purification*, Pt. 1 (1937).

ELIMINATION REACTIONS IN ORGANIC CHEMISTRY

MECHANISM

IN classical organic chemistry, two empirical rules, each of limited application, summarize the regularities which have been observed to govern the formation of olefins from alkyl compounds. Hofmann's rule (an extended form of the rule originally given by Hofmann), applying to primary alkyl groups in ammonium or sulphonium hydroxides, refers to the preferential production of the least alkylated of the possible alkyl ethylenes. Saytzeff's rule, relating to secondary and tertiary alkyl groups in alkyl halides, expresses the predominating formation of the most alkylated of the possible alkyl ethylenes. Having regard to the close analogy of the elimination reactions of 'onium salts and halides, the contrary tendencies of these two rules is striking. The need for an explanation was strongly emphasized when in 1927 Hofmann's rule was rationalized as a manifestation of the inductive effect[1], that is, of a very general type of molecular polarization, which must from its nature oppose the operation of Saytzeff's rule. We have since been much concerned with the problem of reconciling and rationalizing the two rules, but the work has not been published, because, until comparatively recently, the solution was not established. An outline is now given as it may still be some time before detailed publication is possible.

We refer first to methods. The data hitherto available for summarization in the two rules are mainly 'orientational' ; that is, they relate to the proportions in which alternative products are formed; such proportions represent at best only the ratios of the rates of simultaneous decompositions. Thus the Hofmann rule refers to the formation of olefins from alternative primary alkyl groups in the 'onium structure, while the Saytzeff rule relates to the alternative isomeric olefins derived from the solitary branched-chain alkyl group of a secondary or tertiary halide. By examining the kinetics of the reactions, we have provided, besides these rate ratios, the individual rate constants, which permit more extensive and much more significant comparison. Thus we are able to include primary alkyl halides, for which orientational data are impossible.

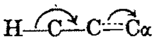
The most important point, however, relates to mechanism. Primary alkyl 'onium salts and halides yield olefins mainly by the bimolecular mechanism *E*2 (attack of a base on an alkyl proton), but the corresponding secondary or tertiary alkyl compounds react partly or wholly by the unimolecular mechanism *E*1 (prior formation of a carbonium ion), and in many cases either mechanism may predominate depending on the conditions. Kinetic control is therefore essential to ensure that only reactions of identical mechanism are compared; and that they are compared on the most appropriate lines. We compare the specific rates for mechanism *E*2, and the ratios in which the carbonium ion is partitioned between elimination and substitution for mechanism *E*1. The comparative simplicity of the results is essentially dependent on the use of the kinetic method.

The data reveal two distinct and characteristic sets of constitutional influences, of which the Hofmann and Saytzeff rules respectively are partial statements: we retain these names for the extended groups of phenomena. Their fields of control are as follows. 'Onium salt reactions proceeding by mechanism *E*2 display 'Hofmann influences'; those going by mechanism *E*1 show 'Saytzeff influences'. Halide reactions by both mechanisms *E*2 and *E*1 are governed by Saytzeff influences. Within the investigated range, these statements remain true no matter whether the alkyl groups are primary, secondary, or tertiary, provided that they are saturated. The introduction of suitably placed unsaturation increases the field of application of Saytzeff influences.

When Hofmann influences are present, the successive variation $R = H, Me, Et$, etc. in $R.\overset{\beta}{C}H_2.\overset{\alpha}{C}H_2.X$ leads to an initial sharp decrease, followed by successively smaller decreases, in the bimolecular rate of elimination. These rate relations, as well as those applying to more complicated alkyl groups, are consistent with the belief that the responsible internal mechanism is the inductive effect: electron displacement in the bond RC_β decreases the induced positive charge on C_β, thereby inhibiting the loss of the β-proton.

When Saytzeff influences are in control, the variation $R = H, Me, Et$, in $R.CH_2.CH_2.X$ leads to an initial sharp increase followed, not by any further increase, but by a decrease of smaller magnitude than the original increase in the bimolecular rate, or unimolecular partition ratio for elimination. These relations, and those observed with more complex groups, are consistent with the theory that the responsible mechanism involves resonance due to the quasi-conjugation[2] of the HC_γ-electrons with the electrons transferred in elimination from the dissolving HC_β-bond to the forming $C_\beta C_\alpha$-double-bond: the energy of quasi-conjugation facilitates this electron transference and thus promotes the proton loss. The greater the number of HC_γ-bonds, the larger will be this effect; and, of course, a much more powerful effect of the same kind arises when, in place of quasi-conjugation, full conjugation is produced by the provision of γ-unsaturation as in the β-phenylethyl group.

Thus for elimination reactions we envisage a situation very similar to that already elucidated for aromatic substitution: independent electrostatic and resonance effects co-exist; and being separately energized they may even work in opposition. When they do, the question of their relative importance assumes special interest.

We expect the importance of quasi-conjugation to increase with the electron defect developed at C_α in the transition state of olefin formation; for the effect depends on the possibility of the electromeric displacement,  in the transition state. We find that in fact Saytzeff influences are subsidiary in the *E*2 reactions of 'onium salts, dominating in the *E*2 reactions of halides, and more strongly dominating in the *E*1 reactions of either 'onium salts or halides; in short, these influences increase when the precursor of the olefin successively contains the groups $C_\alpha—\overset{+}{X}$, C_α—Hal, $\overset{+}{C}_\alpha$. The electron defect at C_α is clearly greatest in the last example; and we may reasonably expect it to be greater in the second than in the first, because the stretching of the C—Hal bond is assisted by solvation due to the charges created by a partial electron transfer from C to Hal, while a corresponding energetic factor is lacking in the activation of the bond $C—\overset{+}{X}$.

We may add that other reactions leading to olefins, for example, those of alcohols and ethers, fall consistently within the theoretical scheme outlined.

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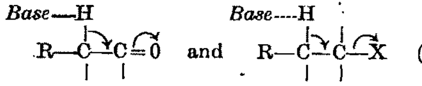
[1] Hanhart and Ingold, *J. Chem. Soc.*, 997 (1927).

[2] Cf. Hughes, Ingold, Masterman and MacNulty, *J. Chem. Soc.*, 908 (1940). This mechanism is identical with that which Mulliken, Rieke and Brown have recently termed 'hyperconjugation' and for the first time treated quantitatively: *J. Amer. Chem. Soc.*, **63**, 41 (1941).

TAUTOMERISM AND ELIMINATION

About twenty years ago the outlook on theoretical problems connected with tautomerism was considerably enlarged by the proposal to regard tautomeric changes, for certain purposes, as internal analogues of additive reactions[1]; thus the study of ring-chain tautomerism developed as a direct consequence of this point of view. It is curious that the complementary and equally valid idea of regarding tautomeric change as an internal form of elimination seems never to have been explored. Consideration shows that it leads to many striking analogies and correlations. This note is confined to a single illustration chosen because it happens to be simply explicable in terms of the preceding communication,

The comparison is between



(X = $\overset{+}{N}$, $\overset{+}{S}$, Hal),

the former diagram representing the rate-determining step of a base-catalysed enolization, the latter an ordinary elimination by mechanism $E2$. The difference is that the combination CO does not break up completely while CX does. The question to be considered is whether the effect of alkyl groups R on the rate of enolization of a ketone (now regarded as an elimination reaction) will be of the 'Hofmann type' or the 'Saytzeff type'. Relatively to CX, the stretching of CO in the transition state must be small, and accordingly the electron defect on the carbon atom and the dependent quasi-conjugation, developed in the course of reaction, may be assumed to be comparatively unimportant. It is therefore not surprising that the effect of alkyl groups on rate is found to be of the Hofmann type. This may be illustrated by Evans and Gordon's results[2] for the rate of bromination (kinetically equivalent to enolization) of phenyl alkyl ketones, CHRR′.CO.Ph in the presence of acetate ions as basic catalyst:

R,R′	H,H	Me,H	Et,H	Pr$^{\beta}$,H.	Me,Me
$10^3 k_{45°}$	52·0	7·99	6·24	3·05	1·55

Examples of 'Hofmann influences' are also to be found in the effect of alkyl substitution on rate of interconversion in the case of 'three-carbon' prototropy.

A contrast to these effects on reaction rate is afforded by evidence that the effects of alkyl substituents on prototropic equilibria are essentially dependent on the same internal mechanism as underlies what have here been called Saytzeff influences on rate (preceding note). The ground states alone are important for equilibria, with the result that, in the tautomerism of olefinic acids, for example, the introduction of a γ-alkyl group shifts the equilibrium in favour of the βγ-form. Consistently a methyl group is more effective in this respect than higher alkyl groups. This effect may be illustrated by the results of Kon and Linstead[3] for the base-catalysed equilibria of the anions of a series of acrylic acids, $RR'C=CH.CO_2H$:

RR′.	Me_2	Et_2	Pr_2^{α}	*iso*-Bu_2
γ-substituent	.H	$.CH_3$	$.CH_2CH_3$	$.CH\begin{smallmatrix}CH_3\\ CH_3\end{smallmatrix}$
αβ-form (%)	100	5	33	49

The importance of quasi-conjugation for equilibria may also be illustrated with reference to anionotropic change. The predominating formation of crotyl and cinnamyl halides in the equilibration of the butenyl and phenylpropenyl halides are familiar examples.

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[1] Ingold, E. H., *Chem. and Ind.*, **42**, 1246 (1923); *J. Chem. Soc.*, **123**, 1717 (1923).

[2] *J. Chem. Soc.*, 1434 (1938).

[3] Cf. Kon and May, *J. Chem. Soc.*, 1549 (1927); Ingold, *Ann. Rep. Chem. Soc.*, **24**, 112 (1927).

FORTHCOMING EVENTS

Friday, July 4

Geologists' Association (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. A. J. Bull: Opening Paper of a Discussion on "Pleistocene Chronology".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Lecturer in Mathematics—The Secretary, Technical College, Sunderland (July 5).

Lecturer in the Department of Mining—The Registrar, University, Leeds (July 7).

Lecturer for the Civil and Mechanical Engineering Department—The Secretary, Northampton Polytechnic, St. John Street, London, E.C.1 (July 7).

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Empire Cotton Growing Corporation. Annual Report for the Season 1939–1940. Pp. ii+34. (London: Empire Cotton Growing Corporation.) [295

Institute of Physics. Twenty-first Annual Report of the Board, 1940. Pp. 16. (Reading: Institute of Physics, c/o The University.) [66

Eating for Victory [illegible]stions for War-time Economy in Foodstuffs. A Sequel to "[illegible] for All". By J. R. B. Branson. Pp. 20. (Bordon, Hants.: Branson's Publications.) 4*d.* [66

Annual Report of the Zoological Society of Scotland for the Year ending 31st March 1941. Pp. 28. (Edinburgh: Zoological Society of Scotland.) [96

Carnegie United Kingdom Trust. Twenty-seventh Annual Report, 1940. Pp. vi+46+2 plates. (Dunfermline: Carnegie United Kingdom Trust.) [96

Institution of Gas Engineers. Communication No. 240: The Gas Industry, 1941 and After: a Symposium. Pp. 60. (London: Institution of Gas Engineers.) [96

Other Countries

Herbertia. Vol. 7, Dedicated to Latin America. Edited by Hamilton P. Traub. Pp. 242. (Orlando, Fla.: American Amaryllis Society.) 3.25 dollars. [285

United States Department of Agriculture: Weather Bureau: Monthly Weather Review, Supplement No. 46: Observations of Nocturnal Radiation at Fairbanks, Alaska, and Fargo, N. Dak. Pp. ii+22. (Washington, D.C.: Government Printing Office.) 10 cents. [285

Field Museum of Natural History. Botanical Series, Vol. 9, No. 6: Studies of the Vegetation of Missouri, 2: Phanerogamic Flora of the Fresh-Water Springs in the Ozarks of Missouri. By Julian A. Steyermark. (Publication 491.) Pp. 477–618+24 plates. 1.25 dollars. Zoological Series, Vol. 22, No. 7: New and Little Known Neotropical Histeridae (Coleoptera). By Rupert L. Wenzel and Henry S. Dybas. (Publication 492.) Pp. 431–472+plates 13–16. 40 cents. Zoological Series, Vol. 24, No. 19: Birds from the Yucatan Peninsula. By Melvin A. Taylor, Jr. (Publication 493.) Pp. 195–226. 20 cents. (Chicago: Field Museum of Natural History.) [285

Geological Survey of British Guiana. Bulletin No. 15: Report on the Geology and Mineral Deposits of the Upper Waini River, North West District. By Dr. D. A. Bryn Davies. Pp. iii+22. (Georgetown: Geological Survey.) 24 cents. [46

Indian Forest Records (New Series). Botany, Vol. 1, No. 7: Contributions to our Knowledge of the Morphology, Cytology and Biology of Indian Coniferous Rusts. Part 1: *Cronartium himalayense* Bagchee and *Peridermium orientale* Cooke on *Pinus longifolia* Roxb. By K. Bagchee. Pp. iii+247–266. (Delhi: Manager of Publications.) 1.6 rupees; 2*s.* [66

Recent Developments in the Science of Plant and Animal Nutrition and their Significance to National Nutrition and Health. Presidential Address to the Section of Chemistry and Biology, 10th Annual Meeting of the National Academy of Sciences, February 1941, by Rao Bahadur B. Viswa Nath. Pp. 31+iii. (New Delhi: The Author, Imperial Agricultural Research Institute.) [66

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